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Ultra High Pressure for Materials Research

VIGNETTE

DAVID D. MOORE

Economics has been defined classically as the science that investigates the conditions and laws affecting the production, distribution, and consumption of wealth. Technology's explosive growth has added new dimensions to the discipline. As Battelle's David D. Moore points out, economics, whether at the level of national and international affairs (macro-economics) or at the level of individual firms (micro-economics), benefits from the technologists' awareness of scientific and technological developments that may have future significance.

Micro-economics has brought forth a new breed of specialist—of which Dave is one. He combines the talents and know-how of the technologist with those of the economist. Such specialists are enhancing the benefits from technological research by providing managements with the means for determining future needs and by helping to prepare to meet those needs.

As Manager of Battelle's Department of Economics, Dave has guided diverse research of basic importance to industrial and governmental organizations. He has been associated with economic studies of basic energy needs; of solid, gaseous, and liquid fuels; of nuclear energy; and of the petroleum industry. One significant study examined the economics of electric, versus open-hearth, furnaces. Dave has directed analyses of the long-range techno-economic potentials of metal, ceramic, plastic, chemical, and agricultural products and materials. Under his guidance, too, research plans have been formulated, and numerous studies have been conducted in the fields of information management, marketing research, area development, and technical diversification. Dave and his colleagues have also undertaken numerous operations research and analytical weapons studies for the military.

After receiving his B.S. degree in chemical engineering from the University of Missouri, Dave, as chemical engineer and plant chemist for the Barnsdall Refining Corporation, worked on a variety of problems dealing with process and product economics. Following wartime service with the Army's Transportation Corps and the Corps of Engineers, he participated in corrosion-control studies for Socony-Mobiloil involving problems of technical and economic feasibility. In 1945 he joined Battelle's engineering economics group, and he has been associated with research on techno-economic problems ever since.

Currently, he is the State of Ohio's representative on the Research Committee of the Interstate Oil Compact Committee. He is active also as a member of the American Chemical Society, the Society for the Advancement of Management, and the American Petroleum Institute.

At home, Dave enjoys bridge, golf, and reading (not necessarily in that order) and watches with interest the gardening activities of his wife, Harriett. Both Harriett and Dave take great pleasure in their two daughters—one in high school, the other in college.

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PULSE-PUMP PRINCIPLES STUDIED

The mechanical simplicity of a pulse pump is apparent in this operating plastic model. Acoustic energy, supplied in this case by the half-dollar-size diaphragm in the wall of the chamber, causes the smoke to enter the duct at the left and move out at the right. The shape and slant of the vaned passages (in the rectangles to left and right of the diaphragm) create "aerodynamic valves" conducive to one-way flow through the pump. A transparent panel in front of the ducts completes the enclosure of the pump chamber. Principles of the pump are being investigated by Carl F. Speich (shown here), Abbott A. Putnam, and their Battelle colleagues—who designed and built it. Large pulse pumps actuated by acoustic energy from pulsating combustion have been used as portable sources of heat for waming engines in the Arctic and for de-icing ships.

1. *Modified Bridgman anvil for combined high-temperature, high-pressure studies. The unit is shown with the carbide pistons supported by multiple binding rings. This configuration has been used for material studies to greater than 3,000,000 psi.*

Ultra High Pressure for Materials Research

The authors describes techniques for achieving unusual combinations of extreme pressures and high temperatures that open new vistas of materials development. Such methods, they believe, will make a major contribution in the search for the materials being sought.

by CHARLES M. SCHWARTZ *and* WENDELL B. WILSON

FUTURE TECHNOLOGICAL PROGRESS IN the fields of power generation, vehicle propulsion, and many other areas will depend heavily upon the development of improved materials of construction for high-temperature service. For example, in the design of an improved nuclear power reactor, increased operating temperature is likely to be the most sought-after goal. The reason is simply one of efficiency of conversion of heat into work, and is based on elemental thermodynamics. Higher temperature operation can only be attained if the designers can be supplied with materials to contain and to support structurally such machines. At present, designers are severely restricted by the limited high-temperature strength and oxidation resistance of available materials of construction.

The limitations of available materials obviously lead to speculation as to possible alternative methods of providing new materials. The physical prop-

erties of a solid material are intimately associated with the nature of the phases which constitute it. In ordinary practice, composition and temperature are the usual variables employed in carrying out phase studies, whereas pressure is often neglected. In materials synthesis, it is common practice to use heat to supply the energy of an edothermic reaction or the activation energy which speeds up the rate of reaction.

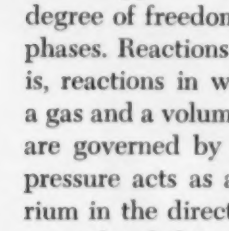
Considerations of thermodynamics and the phase rule suggest, however, that pressure, as another degree of freedom, may be capable of producing new phases. Reactions involving condensible systems (that is, reactions in which either a reactant or product is a gas and a volume change occurs during the reaction) are governed by the system pressure. In such cases, pressure acts as a driving force, shifting the equilibrium in the direction of decreased volume. This is an example of the application of the Le Chatelier principle, which specifies that if a change is made in one of the factors determining equilibrium conditions, the equilibrium shifts so as to annul the effect of the change. The principle is quantitatively expressed in terms of the second law of thermodynamics and the free-energy change of the reaction. It has been employed for a number of years in the laboratory and on a large scale for production purposes.

Among the better known examples of industrial use of high pressure are the Haber process for the production of ammonia gas from nitrogen and hydrogen, the various high-pressure reactions in the petrochemical industries, and the synthesis of plastics such as polyethylene. Large-scale applications rarely exceed 15,000 psi, owing to practical limitations of the strength of the containers.

Effects of Pressure on Liquids and Solids

The effect of pressure on equilibria in condensible (gas) systems, in which the volume change is appreciable, has been well established. Is there evidence, as well, of pressure effects on condensed systems, that is, on liquids or solids? The effect of pressure in shifting the equilibrium of the reaction in liquids and solutions has been demonstrated in a number of cases. An example is the shift toward the cis isomer in the equilibrium between cis and trans 1:2 dichloroethylene, which shift is in the direction of increased liquid density. The effect of pressure on chemical reaction kinetics is also well known. For instance, pressure causes a large increase in rate of polymerization of liquid olefins like styrene. In this case, it is believed that pressure aids the reaction by forcing the molecules to be favorably aligned.

Can we expect similar effects in solids, especially metals and inorganic compounds? Our knowledge of the structure of solids should supply some clues. We know that in these substances the bonds are stronger, the densities are higher, and higher pressures are needed to produce physical or chemical transformations. Nevertheless, the compressibility of solids, though small, is finite and measurable. We know, too, that in the case of many elements and compounds which exist in two or more crystalline forms, the high-temperature stable form is the more symmetrical structure, and consequently its atoms are most closely packed. In a few instances, it is possible, by chemical additions, to stabilize the high-temperature form so that it is retained at lower temperature. Thus, addition of a few per cent of lime or one of the rare earths to zirconium dioxide stabilizes its high-temperature cubic structure, producing a material which does not transform on heating. Stabilized zirconia is an important refractory, free from the effects of spalling or



Dr. Charles M. Schwartz has participated in and guided much of the Institute's research in the structure and chemistry of reactor materials and diverse other metallic and nonmetallic materials. X-ray diffraction, microscopic, and electron-microscope methods have been ultilized in much of that research. However, as the demand for higher temperature materials has increased, new methods of materials preparation and analysis have been required. Dr. Schwartz and his colleagues have responded by developing advanced ultrahigh pressure apparatus and an X-ray diffraction camera for phase studies, both for use at unusually high temperatures, and a unique electron-probe microanalyzer to handle problems of solid-state reactions.

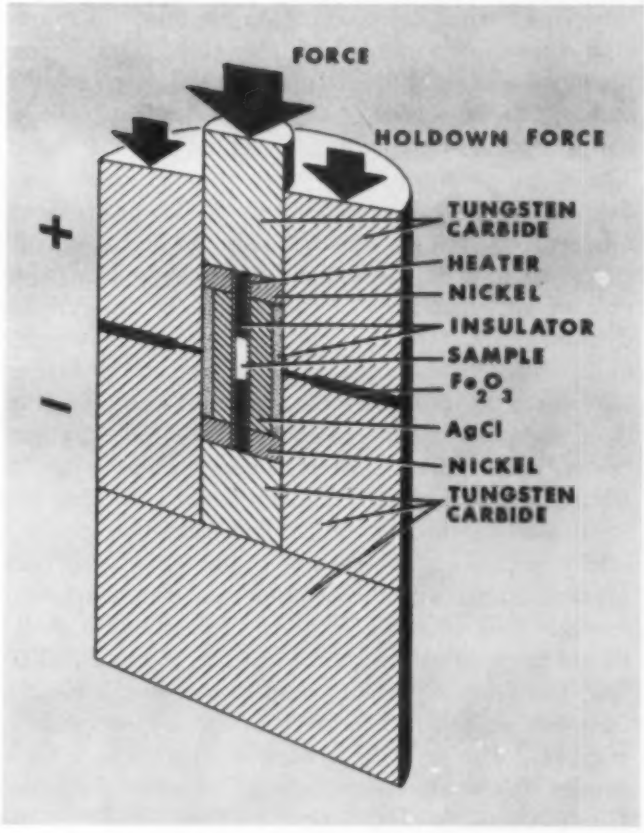
Wendell Wilson's interest in high-pressure research stems from his experience in research on high-temperature materials. The possibility of obtaining new materials through use of combined high pressure and temperature led to his participation in the current work at Battelle on improved apparatus and to his development of a design for advanced ultra-high-pressure equipment. Wilson's research has been largely concerned with solid-state studies of high-temperature reactor components including crystal-structure studies of the uranium oxides and stabilization of uranium dioxide. He was formerly Senior Engineer in charge of the metallography, microscopy, and diffraction laboratories of General Electric's Aircraft Nuclear Propulsion Project.

cracking due to phase transformation. Since increasing pressure favors the phase of higher density, it might be possible, if a high enough pressure were applied, to transform some solids into more dense forms not observed in nature.

Assuming that pressure causes phase transformations as predicted, there remains the question of the stability of any newly formed phase and its possible reversion to that form which is thermodynamically stable at low pressure. To find the answer, we look to some natural examples. Although most phase transformations are reversible with temperature change, fortunately, there are many transformations known to be so very sluggish that if the high-temperature form is cooled with sufficient speed it is retained in a metastable condition. The diamond is a classical example; it is metastable and reverts to grapihte on heating. However, this reverse transformation is exceedingly sluggish, and diamond is normally considered a relatively stable material. Thus, there is evidence that high-pressure phases, once synthesized, would exist metastably over a useful temperature range and for a sufficient time to be of use in some applications.

As indicated previously, pressure should have an effect, not only on equilibrium conditions, but also on reaction rate. However, in the case of solids with ionic or covalent bonding, which are of interest to this discussion, there are no molecules, as such, to be aligned by pressure; instead the effect is to increase bond strengths and thus to lower the reactivity. On the other hand, raising the temperature has the opposite effect on bond strength, owing to the increased thermal vibrations and separation of the atoms or ions. This increases the chemical reactivity and thus counteracts the effect of pressure. In fact, most reactions to form materials, as in the synthesis of diamond, would be much too sluggish at room temperature to be of economic value, and thus the use of heat simultaneously with pressure appears mandatory. This requirement imposes a severe restriction on the design of ultra-high-pressure apparatus, as will be apparent in the following discussion.

What pressures might be needed to cause transformations in refractory solids? In order to gain some insight into this matter, let us consider nature's capabilities and methods. The calculated pressure at the interface between the core of the earth and the mantle is over 15 million psi. Even at a depth of only 250 miles below the surface, the pressure is greater than 1½ million psi. If, then, we are to simulate geological processes in the laboratory, we should attain or exceed the latter value of pressure, and at elevated temperature.



2. *A cutaway drawing illustrating a right-circular cylinder-type die with a typical sample configuration in place. This has been the most commonly used die design. Pressures up to 750,000 psi, combined with very high temperatures, are possible with this unit.*

Ultra-High-Pressure Apparatus

P. W. Bridgman of Harvard University, who spent many years in the design of high-pressure equipment and in the study of its effects on the properties of materials, is responsible for a significant portion of our present understanding of the subject. In general, the bulk of his work was conducted in liquid-pressure vessels devised to provide truly hydrostatic compression to 450,000 psi essentially at room temperature. He investigated numerous elements, intermetallic compounds, simple salts, and some organic compounds. His studies provided data on compressibility and changes in electrical resistivity useful for detecting any transitions that might occur under pressure. More recently he has developed apparatus suitable for pressure research to 1,500,000 psi and beyond. Generally he has worked near ambient temperature, determining a number of transition points which are the basis for pressure calibration in other apparatus.

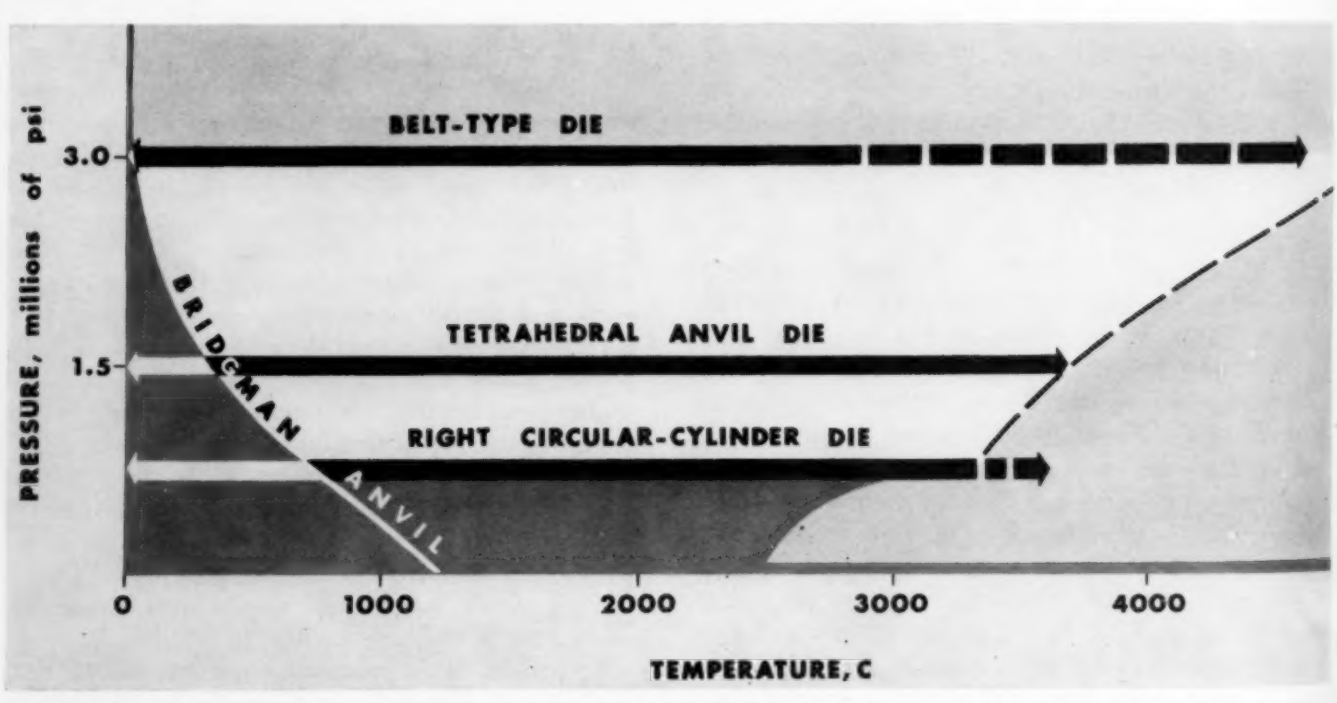
Bridgman's work was extended by others, with emphasis on synthesis. L. Coes, Jr. of the Norton Company, and later, H. T. Hall of the General Electric

Company devised methods of simultaneously obtaining high temperature and high pressure. The former produced coesite, a dense form of silica, not found in nature. His apparatus consisted of a cylinder die of hot-pressed alumina, with a cemented carbide piston. The G.E. work culminated in the production of diamond and of Borazon, a cubic form of boron nitride. Details of the apparatus are not now available.

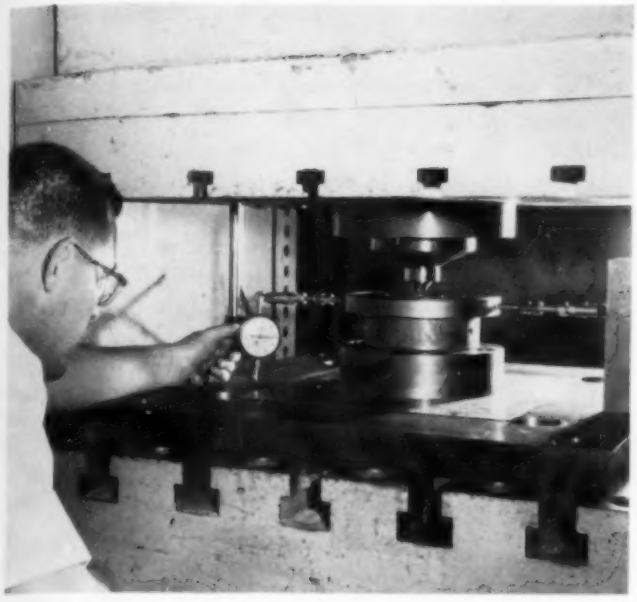
The simplest form of high-pressure apparatus capable of applying heat to the sample is the cylinder die and piston. The die and piston are usually made of cemented tungsten carbide, which has the highest strength in compression of any material available other than materials like diamond. The die must be supported against tensile stress, since carbide is not as strong in tension. To accomplish this, the die cylinder is encased in binding rings. The maximum pressure attainable, about 750,000 psi, is limited by the compressive strength of the unsupported piston, where it emerges from the die. Heat is applied internally by means of electrical resistance heating, as described below. The sample, in the form of a short rod, is encased in a thin-walled tubular resistor of, say, graphite or platinum. The resistor, in turn, is encased in a close-fitting, thick-walled insulating cylinder of unfired Grade A lava. A bottom plug, insulated from the die, makes contact with the resistor tube, and current is passed through it and the resistor tube (and the specimen, if it is electrically conducting) to provide heating. Figure 2 is an early Battelle design, with the die split horizontally to permit electrical insulation between the halves, avoiding the need for an insulated bottom plug. The die is water cooled. This design has performed satisfactorily up to 750,000 psi and at temperatures to 3000 C.

An obvious method of increasing the pressure capability would be to support the piston by encasing the entire die within a liquid-filled container under hydrostatic pressure. Bridgman employed this principle to reach 1,500,000 psi in apparatus in which the Carboloy piston and the cylinder were surrounded by liquid at 450,000 psi. The crushing strength of the carbide increases only by approximately the applied external pressure; thus, it would not be practical to apply this method in an attempt to reach much higher pressures. Furthermore, use of a liquid-pressure transmitter makes difficult the application of heat; hence, this design is of limited value.

Another concept, that of massive support of the piston, was employed by Bridgman in his "anvil" unit. The Battelle version of this apparatus, Figure 1, consists of two abutting pistons of cemented carbide, with one or both working surfaces in the form of a flat truncated cone. The sample diameter, and thus the area of the presure zone is much less than that of the piston, so that binding-ring support is essentially provided over the entire length of piston. The sample is in the form of a thin disk, about 10 mils thick, placed within a gasket ring of talc-like pipestone. External heat is supplied from a tube furnace surrounding the



3. *Ranges of pressure and temperature now available with recently developed dies. The darkly shaded portions indicate the older ranges.*



4. An advanced die design concept, known as the "girdle", currently being investigated at Battelle. This unit is an extension of the Bridgman anvil modified to provide internal heating.

pistons. Pressures to 3,000,000 psi have been obtained with this apparatus, at room temperature. Temperatures up to 1000 C have been used, but owing to loss of strength of the die materials, the available pressure is not over 300,000 psi at this temperature. The Bridgman anvil, supported under hydrostatic pressure in his 450,000 psi apparatus, reached 6,000,000 psi. This value is higher than that predicted on the basis of the results using the cylinder die under hydrostatic pressure. It is believed that the combination of massive support and hydrostatic pressure interact to give increased strength.

Despite the rather limited range of temperature and the pressure restrictions imposed by temperature, the Bridgman anvil has been used by a number of workers, especially in the field of minerals synthesis. It is highly attractive for laboratory use because of its extreme simplicity and low cost.

The General Electric Company has made diamond and Borazon in apparatus maintaining about 1,500,000 psi at temperatures up to 2000 C, for extended periods of time. The method has not been disclosed. Hall has described a fully supported die, consisting of a compressed region in the shape of a regular tetrahedron, rather than cylinder or disk, as in other known designs. Four pistons of cemented carbide are constrained by means of hydraulic cylinders to move along lines perpendicular to the triangular faces of the tetrahedron. The piston faces are triangular anvils, and are beveled so as to nest together. Binding rings encase the carbide, to support the tensile forces which develop. The sample is in a heater tube supported within a pyrophyllite tetrahedron contained in the volume enclosed by the four anvils. Internal electrical heating is employed. This is called the "tetrahedral-anvil" apparatus. Other die designs are being studied at Battelle and elsewhere, and it is hoped that technological improvements will result in step-by-step extension of the range of ultra-pressure available in the laboratory and in the plant.

Applications of Ultra-High Pressure

The synthesis of diamond was the culmination of the dreams of many men. In earlier years it would have been considered a greater feat than the discovery of the Philosopher's Stone, although certainly, today, we should have to recognize the field of nuclear transmutations as more spectacular. Since the density of diamond is considerably higher than that of graphite, many early attempts were made to employ heat and pressure to synthesize diamond, but with no success, or at best, with very dubious evidence. These failures prompted a critical study of the thermodynamic criteria for the transformation. In the case of the element carbon, we are particularly fortunate in that considerable thermodynamic data are available for both the stable allotropic form, graphite, and metastable diamond. From these data it was concluded, according to a recent computation, that at room temperature, diamond is the stable form above 225,000 psi. Bridgman, however, made several unsuccessful attempts to make diamond, reaching pressures above 3,000,000 psi at room temperature. Thus, in this case, the reaction rate is too slow, and the temperature must be raised to provide the needed activation energy for rearrangement of the atoms. At higher temperature the equilibrium pressure increased; at 2000 C, say, over 1,000,000 psi would be required, according to the calculations.

On the other hand, Borazon, the cubic form of boron nitride, never occurs in nature. Its possible existence was predicted on the basis of the structure and properties of the ordinary hexagonal polymorph. Hexagonal BN is soft and flaky, with easy slip between the platelets, exactly like graphite. The cubic form has the structure and hardness of diamond, but has better oxidation resistance.

Coesite, the high-pressure form of silica, has a density of 3.01 g/cm^3, compared to 2.65 for quartz. It was prepared from silicate and mineralizer at 525,000 psi and 750 C. The question of why coesite is not found in nature is intriguing, for these conditions are certainly readily available in the earth's interior. The answer may lie in the unknown relation of the

cooling rate to the rate of pressure release. In order to retain a high-pressure, high-temperature phase as a metastable phase at room temperature, it is necessary to cool first, while under pressure, before releasing the pressure. A number of other natural minerals, most of them siliceous, have been synthesized in the laboratory through the use of high pressure and elevated temperature. These include garnets, sillimanite, kyanite, and topaz. In Battelle's laboratory, studies of the uranium-oxygen system have led to the discovery of a new form of U_3O_8, whose properties are as yet unexplored.

Conclusion

To summarize, we have seen that ultra-high pressure may be used to promote transformations and reactions, and thus to act as a "universal catalyst" for production of new materials. It should be pointed out, however, that there is another important area of application, which though not directly connected with synthesis, may ultimately prove of considerable value in materials studies. This subject is the use of ultra-high pressure as a research tool to improve our knowledge of solids and solid-state theory. There is a small but growing amount of research in this field for which the possibilities appear to be nearly unlimited. This topic is, however, outside the scope of the present discussion.

The startling achievements in synthesis using high pressure, as illustrated by the examples above, focus attention on the real potentialities for future discoveries. Certainly, it will be possible to make new materials, but the way is neither paved nor lighted. It will be necessary first to embark on a systematic study of a large number of materials in order to establish a pattern for progress, and to develop an understanding of the theory and mechanism of the solid-state reactions.

In the fields of mineralogy and geology, the possibilities have already been explored. A large amount of work is waiting to be done in the pressure-temperature range already available. Furthermore, each new advance in the capabilities of the "hardware", will open new horizons of application. This research should lead ultimately to further knowledge of the physics and chemistry of the earth.

The application of ultra-pressure research to metallurgy also offers attractive possibilities. The production of high-density phases of increased symmetry, the use of pressure to squeeze out voids, vacancies, dislocations, and other crystal imperfections, thus improving the mechanical properties of the material, are typical examples of the types of improvements to be expected in metal systems.

VIRUS OF FREEDOM

"In the ideological war the scientific discipline is not merely the indispensable condition of survival; it stands four square with humanism and morality on the side of freedom. For science . . . is not primarily a subject, or a series of subjects, but an attitude of mind, and specifically the attitude of mind actuating those who seek the truth . . . by experiment and experience . . . The scientist is driven by his very terms of reference to seek and publish the truth . . . Though the scientist remains as vulnerable as his neighbor to political and moral error, he is yet unlikely to accept indefinitely or corporately the political or moral indoctrination of a tyrannical system of government tied authoritatively to a body of *a priori* assumptions . . . It is this which causes me to proclaim my faith and hope in the scientist . . . He can penetrate those barriers without political motives or even while himself suffering from political delusions, but he himself carries the virus of freedom . . ."

Viscount Hailsham

Adhesives Gird for New Tasks

1. *After the formulation of an experimental bonding compound, its effectiveness is evaluated. Here the technologist is bonding various combinations of materials to determine a compound's potential applications.*

by CHARLES W. COOPER *and* HERBERT N. JOHNSTON

A widening variety of adhesive systems enables the economic bonding of more and more materials and permits forming of shapes not possible with other fastening methods. The authors present the trends in adhesive technology and suggest new areas where adhesives are likely to be useful in the future.

IT IS WELL KNOWN THAT ADHESIVE products and bonding techniques form an important part of modern manufacturing practice. However, the mushrooming growth of the adhesive industry and its present and future impact on our economy bear a second look. Some of the more mundane, less-noticed uses of adhesives represent fantastically large markets. For example, a reported 10-million pounds of adhesives were used in 1957 for applying labels to beer bottles, and as far as variety is concerned, a total of seven different types of bonding agents are required to bring a package of cigarettes to the consumer. Adhesive products are moving into much more spectacular types of end use than these—some of which, by their nature, will most certainly rival the biggest current single applications.

Until the beginning of the present century, animal glue dominated the adhesive field. If bonding methods

were used, it was virtually the only available high-strength material. Pastes and mucilages, based on water dispersions of starches or gums, were also available, but their limited strength, of course, restricted their use. The rosins, pitches, and tars that come under the heading of naval stores might also be considered as early adhesives, but, used alone, they were more applicable as caulking agents, sealants, or water-resistant surface treatments.

Animal glue was the dominant material in an era whose structures were basically of wood. Due to properties peculiar to the protein collagen on which glue is based, it remains an important product today in the bonding of wood and other cellulosics in segments of our industry.

The casein-based adhesives, known since the 1870's, found some use in assembling wood aircraft components during World War I. They were selected because of their excellent weather resistance. Casein, together with soybean flour and blood albumin, have also found wide use in veneers and plywood. The plywood and, more recently, the particle board industry consume high tonnage quantities of adhesive products. According to U. S. Department of Commerce figures, the softwood ply production alone accounted for over 51,700 tons of adhesives as long ago as 1951 (about twice the quantity consumed in 1946). If one adds to this the hardwood products which represent about half the volume of softwood, the effect on the total adhesive market is tremendous. The consumption of natural and synthetic types in softwood plywood is estimated to have reached about 97,000 tons in 1957. Demands and standards set by the industry form a constantly changing picture with respect to adhesive types supplied.

Synthetic Adhesives

The adhesives industry underwent a revolution with the development of synthetic products. Through the expanded and widely selective properties that became available in specially compounded products, adhesives provided effective fastening for a wide variety of materials, structures, conditions, and products. The growth of synthetic adhesives perhaps had its greatest boost with the development of the plywood and aircraft industries. The demands of the plywood industry included greater heat and moisture resistance; aircraft manufacturers needed, in addition to moisture resistance, high strength, high temperature, and creep-resistant materials capable of bonding metal to metal and metal to other materials to form sandwich-type structural members.

The numbers and types of adhesive products now available are almost limitless and, although this is an advantage, it tends to confuse the potential user. Guideposts in the selection of the proper adhesive will be outlined in a subsequent section. However, some of the forms in which synthetic materials are available should be mentioned first. They may be obtained in water solution, in aqueous dispersion incapable of being redispersed or even seriously attacked by moisture after drying, in solvent solution as thermoplastics (heat softened), or in thermosetting compounds incapable of being heat softened after a curing cycle. The latter two classes may be elastomeric or rigid in character and may be employed as so-called contact cements. This means that they may be applied to two mating surfaces, dried, and assembled after the solvent has evaporated, thus eliminating the problem of trapped solvent in nonporous structures. Fluid adhesives are also available as solvent-free formulations that are curable or that can be applied as hot melts. These require no volatile components and thus eliminate the problem associated with their presence.

The improvement in the strengths of adhesives has

C. W. Cooper long has been concerned with research on basic adhesion problems, the development of new polymers, and the formulation of special adhesives and sealants. Problems in the application of adhesives to packaging, footwear, synthetic films, metals, and wood and other cellulosic materials have engaged much of his attention. At Battelle, Cooper has also explored plastics molding techniques, methods of wood treatment, and radiation polymerization problems. Earlier, with duPont, he participated in research on regenerated celulose.

Research on adhesive problems has also held the interest of Battelle chemist Herbert Johnston. He has helped devolop adhesives for corrugated board and other products and has done research on bonding such materials as vinyl and metal, armature windings, a wide variety of labels, and water-resistant paper. Studies of organic coatings for metals and impregnation techniques and coatings for papers and other materials form an important part of his research activities. Prior to joining Battelle, Johnston was associated with the development of lacquers at the Glidden Company. Currently, he is a member of the Corrugated Containers Raw Materials Committee of the Technical Association of the Pulp and Paper Industry.

made them available for use in applications formerly closed to such materials. Many organic adhesive materials—especially those of the aircraft type—are highly heat resistant and offer bond strengths in the 4000 to 5000 psi range. Others promise strengths to 10,000 psi. Of course, such factors as end use, the size of areas to which cements are applied, and the type of stress (shear or peel) will determine the degree of strength necessary.

The Case for Adhesives

The rapid growth of adhesives in the past resulted largely from the demand for uniform structural materials ranging from plywood to corrugated board. At the same time, the aircraft, marine, appliance, furniture, container, building, and other industries have been effectively demonstrating another advantage of adhesives—they permit the use of structural methods that can provide products of specialized shapes. Such uses promise to create greater demands for adhesives in the future.

The many advantages of adhesive bonding include: (1) the joining of components more rapidly and economically than by older, more conventional methods; (2) the production of new structural or composite units—for example, laminates such as doors, panels, table tops, and honeycomb sandwich forms; (3) the even distribution of stress to increase total strength (the construction of helicopter rotors is a prime example of this); (4) obtaining surfaces free of holes or protuberances or with unusual contours; and (5) the formation of better seals against moisture, fluids, or gases, and the ability to present a less penetrable and more corrosion-resistant surface.

The adhesives industry is one of phenomenal growth and, as such, represents an area of relatively good customer acceptance of new materials and methods. Nevertheless, it is also an industry in which technology has outstripped possible end uses. One reason for this is the lack of understanding of the advantages, in many areas, of replacing mechanical with adhesive fastening methods. Such factors as the need for better quality in products along with the lower manufacturing costs will lead more and more industries to investigate, and then use, adhesives.

Adhesives as Systems

Adhesives have, on occasion, been either bypassed or replaced on the production line by more expensive and, frequently, less effective fastening methods. There are two main reasons for this. One of these is the probability that a particular adhesive has been incorrectly used and the other—a corollary to the first—is that insufficient consideration has been given to the fact that any bonding process should be considered as a total system.

The factors to be considered in defining and establishing the needs of a system are not particularly complicated when they are carefully and separately analyzed. Some of the more obvious ones are listed below, but not necessarily in the order of their importance, since the order is often determined by a particular application.

Economics. Problems of cost are naturally important in selecting a fastening method and many factors enter into the determination of the economics of various fastening systems. To be considered when comparing adhesive and nonadhesive fastening methods are materials, degree of skill and amount of labor required, equipment, surface preparation, and space requirements. Production convenience is also a matter of importance. The speed of an adhesive system versus other methods is frequently favorable. Adhesives are readily adapted to assembly line techniques and should be considered in many instances where welding, riveting, soldering, nail and screw assembly, sewing, and other techniques of fabrication are now in use.

Properties. The function of joining two items should be defined in terms of maximum strength needs to permit the proper selection of an adhesive and to prevent under- or over-engineering the joint. Greater strength can often be obtained with adhesive systems than is possible with conventional mechanical fastenings. Extremely high strength is possible, of course, with relatively large bonding areas. Stress loading of the finished article is also important, and if joints are loaded in "shear", or if redesign will permit this, adhesive bonds exhibit maximum performance. If the product is to be subjected to flexing, it will naturally require a flexible bond which adhesives can often supply. Also, special properties such as heat and/or water resistance can be "built" into the product by the adhesive and polymer chemist.

Surfaces. Surface characteristics of materials to be bonded can seriously influence the effectiveness of a bond. Therefore, it is important to study such factors in surfaces as their porosity, polarity, similarity or dissimilarity, heat resistance, and sensitivity to water or solvents. Proper cleaning of the surface is also important, since adhesives often fail because dirt or lubricating agents have not been removed from the products. Thus the nature of the surface involved plays a significant role in selecting the adhesive system.

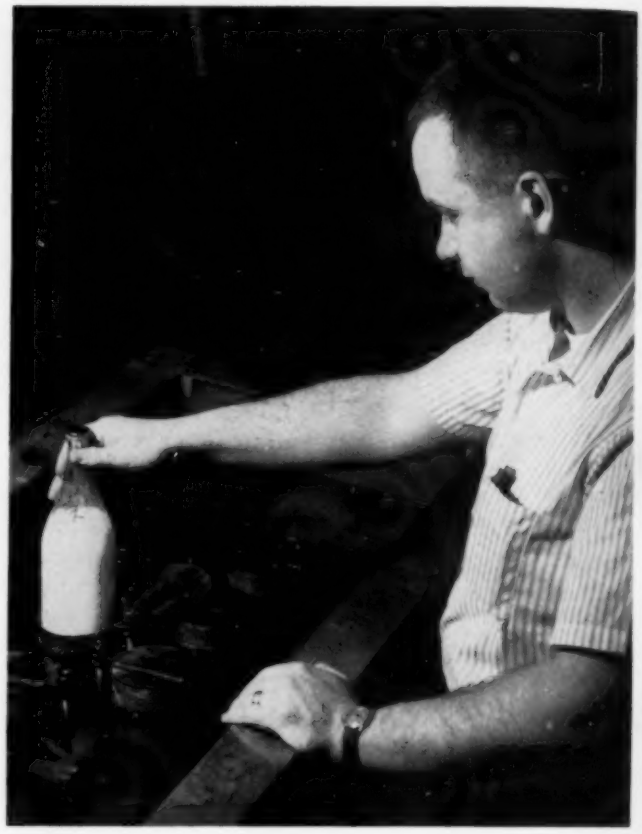
Application. Adhesives can be applied by almost all coating techniques. These include brush, spray, knife

coating, electrostatic deposition, dipping, and others. Also, the adaptability of the product to either hand or machine lay-up techniques can be a determining factor if a change is needed to adapt a process to making an adhesive joint. However, with the variety of adhesive materials available, different methods are usually possible in any given application, thus often making mechanical adaptation relatively simple.

Curing. Evaluating various curing or "setting" systems is usually necessary in designing a good production method. Frequently several different methods can be considered, depending on the adhesive and the product to be bonded. Dielectric heating, cold set, room temperature catalysis, solvent activation, conventional heating methods, and combinations of these can be considered. Continuous or intermittent production may impose other restrictions on the curing system. If work must be interrupted, the adhesive can be applied to the separate surfaces before assembly. The parts may be assembled at a later time by solvent or heat reactivation or, in the case of contact adhesives with residual tack, sufficient cohesive strength is often possible by applying light pressure to the joint.

The specifications of the finished article must also be considered in selecting the adhesive best fitted for the product and the process. A product's end use, aesthetic appeal, environment, and anticipated life are all important. Furthermore, the required strength and the character of the component parts of the assembly determine, to a considerable extent, the adhesive requirements. For example, there is little need for using a high-temperature-resistant, extremely high-strength product to assemble realtively weak materials that will never be exposed to anything more severe than room-temperature conditions.

Perhaps a particular and well-known type of bonding problem will illustrate the method by which an adhesive might be selected. If a heat-resistant polyester laminate is to be bonded to wood, as in the case of counter tops, cost, although important, is not one of the prime considerations because of the relatively expensive materials being bonded. Adhesive bonding is certainly the most convenient, if not the only, possible method. Strength requirements are moderately high and, with the large surfaces involved, high strength is easily obtainable with adhesives. The surfaces to be bonded are both porous and nonporous, but both are polar in nature. A resinous but slightly resilient high-tack material is indicated so that a resin-rubber compound represents one of the more appropriate materials. It may be applied to both surfaces from solution by any of the known techniques. Following this, the solvent may be allowed to evaporate (since one surface is nonporous) and assembly may be accomplished after drying. The residual tack of the adhesive results in the development of high cohesive strength. Time and labor are at a minimum and hand or machine application may be used. Hazards may be kept under control, since much of this is custom work. The use of an adhesive, however, is certainly adaptable to continuous or intermittent production and, although flexibility is not important after assembly, a flexible adhesive is not subject to damage in the separate handling of the thin outer portion of the counter.



2. *Preparation of experimental emulsion polymer for a specific adhesive application. This equipment provides the controlled conditions required for a variety of polymerization processes.*

Long life and heat resistance are anticipated and the adhesive selected will supply these properties. High strength, at least equal to the weakest member, is possible and the aesthetic nature of the product is preserved. No holes are necessary, and an impenetrable surface—certainly of high importance in counter use—is provided.

Basic Concepts of Adhesion

The present and future utility of adhesive in the assembly and construction of extremely diverse ma-

terials has resulted in an ever-deepening probe into the theory of adhesion. In the past few years, a large number of workers have contributed valuable knowledge through their study of this phenomenon. Factors studied included cohesive strength and thickness of the bond layer, general types of surfaces, the effect of surface roughness, capillarity, and a simplified explanation of good surface contact referred to as "wetting". This latter term, indeed, has come to mean much more in reference to adhesion than it once did.

In more recent years, greater emphasis has been placed on the study of the more theoretical thermodynamic aspects of adhesion—for example, the forces of molecular attraction, primary bonds (electrostatic, covalent, and metallic), secondary bonds, (orientation, induction and dispersion forces), and surface activity. The belief in the existence of mechanical adhesion, if such a condition exists at all, has given way to an explanation of good bonding action as specific adhesion. Thus, it is now recognized that surface roughening contributes to bond strength mainly because it results in a truly clean and active surface with molecular forces available to react with the adhesive.

As in other areas of research, almost as much can be learned from mechanisms of failure as can be explained by investigations of bonding action. Theoretical work is constantly contributing a better understanding of the problems involved and should eventually eliminate any need for tests that are really trial-and-error in nature.

Considerable work is also being done to obtain more information about established, as well as new, adhesive application methods. Studies are under way to determine the amounts of adhesive applied by various types of equipment and the effect of machine speed, machine set-up, and other factors in the quality of the product produced. Results of such studies are useful in the design of new equipment, as well as in the formulation or compounding of new adhesives. Studies of this type have been made possible by focusing the talents of various researchers, including polymer chemists, analytical chemists, physicists, and mechanical engineers, on particular areas.

Future of Adhesives

It is believed that the prospect for the future growth of adhesives is at least as bright as that of the immediate past. Consider the presently available forms—curable nonvolatile fluids, adhesive films and tapes, adhesive "rods" fused as needed and heat reactable, expandable, contact, conductive, insulating, elastic, rigid, and moisture impermeable products. Several of these are available as both thermoplastic and thermosetting types. Consider also the variety of application methods—brushing, spraying, knife coating, troweling, dipping, proportioning guns for mixing two component products in exactly correct ratios, and even electrostatic deposition for dry materials. These factors emphasize the broad base for future development.

Some of the more recent cases in which continuing growth is expected include curtain wall construction in large building trades, marine assembly, automotive (the plastic body of the Corvette is entirely bonded by adhesives), trailers, scientific instruments, cameras, optical equipment, duct work, appliances, and one of the biggest uses, packaging and labeling. Much more remains to be done. The automotive field can use increasing amounts in bonding body stiffeners, trim and ornamentation, upholstery, and other parts. The metal and plastic furniture industry can expand its utilization of adhesives. A long period of research in bonding tin can tops, bottoms, and side seams may soon pay off. Adhesives will probably soon invade home building to a greater extent. Whole wall sections could be preformed or bonded on the job, thus eliminating costly nailing; conventional flooring could also be laid with adhesive products. Roof sections could be similarly applied.

Plumbing is another likely target. Adhesives with capillary action could be used in place of solder for copper joints and may even make way for aluminum piping. Steel piping may also become more competitive through the use of adhesive products as a substitute for conventional threading. Aluminum gutters and downspouts, already a reality, could be assembled on the job with adhesive products rather than by riveting and sealing. There is virtually no end to the fastening jobs adhesives may perform, and eventually they will be as common in these presently unusual areas as they have been for years in the furniture and cabinet industry.

Of the more unusual adhesives, single component, curable compounds are now a reality. These eliminate mixing on the job. Contact adhesives, because of their ease of assembly, are becoming more and more common. Double-faced "sheet-form" adhesives designed to bond two different types of surfaces by the application of heat are already available. Ceramic and "cermet" adhesives are filling needs in areas of extreme high temperatures.

Envisioned are products with greater specificity, improved resistance to high temperatures, weathering, water, solvents, oils, and greases, adhesives that can be used on greasy or dirty surfaces for better performance in field application, and others. With the properties now available and under development, almost every product can in some measure be adapted—and probably advantageously—to adhesive bonding.

NOTES from BATTELLE

* OXYGEN NEEDS OF SPACEMEN

Man's ability to extract oxygen from the air, use it, and then exhale it in the form of carbon dioxide is basic to his survival. On anticipated manned space flights involving months or years, not enough oxygen can be carried aboard a space vehicle to sustain a man, unless a way is found to recover and re-use a large part of the oxygen. Since the oxygen a main breathes is not permanently lost, but merely exhaled in a different chemical form, the problem is one of finding a practical way to free oxygen from exhaled carbon dioxide. If this can be done, oxygen may be used over and over again by the man confined to a space vehicle.

Scientists at Battelle have begun research to design and develop a practical system for freeing oxygen from carbon dioxide. Specialists at the Institute are conducting the one-year study for Wright Air Development Center's Aero Medical Laboratory to assure spacemen an adequate supply of breathing oxygen.

"There are at least three possible ways to recycle a limited oxygen supply", according to Dr. John F. Foster, who is directing the research at Battelle. "We can conceive of a system that employs extreme heat to free oxygen from carbon dioxide, another system that reverses the basic processes of human metabolism by a chemical reduction, and finally nature's own method for accomplishing this—photosynthesis. The system we finally adopt will be the one that most nearly meets the requirements set forth by the Air Force.

These are some of the specifications that Battelle specialists must meet in designing the carbon dioxide reduction system: It must be capable of processing carbon dioxide at a rate that will provide oxygen for one or two men for periods from one month to three years. The system must be able to operate efficiently in an atmosphere that is only about one-third as dense as the earth's atmosphere at sea level. Since power will be at premium aboard a space vehicle, the system must operate on a minimum of electrical power and heat energy, or a combination of both. The system must not be dependent in any way upon the force of gravity. The system must, of course, be as lightweight and compact as possible and operate efficiently with a minimum of maintenance.

"Of the three approaches to this problem," Dr. Foster reported, "chemical reduction seems, at this time, to most nearly meet Air Force requirements. With this system, we would use a reducing agent to convert carbon dioxide into solid carbon. Then, in a follow-up step, we would recover the oxygen as a gas. The comparative simplicity and reliability of such a system weighs heavily in its favor," he observed.

The Battelle scientist did not rule out the use of photosynthesis—the chemical process by which green plants manufacture their food supply and give off oxygen. He conceded that a system employing plant life offered long range possibilities that are quite attractive. Among other things, the plants themselves might serve as a source of food for spacemen. "Artificial" photosynthesis—the accomplishment of the same action without the intermediary of plants—would be ideal. However, Dr. Foster points out that "it seems improbable that a practical system could be developed as quickly as a chemical reduction process".

So-called thermal decomposition—a method of freeing oxygen by the use of extreme heat—seems to be the least practical of the three approaches to the problem. Poor efficiency and weight of equipment required all but rule out this possibility, Dr. Foster stated.

* DEPLETED URANIUM USE STUDIED

A study to determine how and in what quantities industry may use depleted uranium for nonnuclear peaceful purposes has been authorized by the Atomic Energy Commission. The three-month technical-economic study, to be completed this month, is being conducted for the Commission by Battelle.

The study implements the Commission's decision to remove restrictions on nonnuclear uses of uranium and make it available to industry on an unclassified basis. Depleted uranium, subject of the new study, is material from which most of the fissionable U-235 has been removed. The depleted uranium is now available in the form of uranium hexafluoride "in substantial annual tonnage on a continuing basis" for processing to the metal ,oxide, or desired compound.

Uranium and its compounds had limited use prior to World War II in such applications as a coloring agent in glass and glazes, as a component in some ferrous and nonferrous alloys, and as a chemical agent in photographic films, negatives, and prints, according to Dr. Harlan W. Nelson, who is coordinating the study at Battelle. A maximum of about 100 tons of uranium was used annually for such purposes before wartime restrictions prohibited such use.

In its study of nonnuclear industrial uses for depleted uranium, Battelle is calling upon its research specialists in metallurgy, chemistry, ceramics, solid-state physics, and economics, Dr. Nelson said. "We will, of course, review the traditional industrial uses for depleted uranium. At the same time, to get a more accurate picture of the future market potential for this material, we will consider new or improved applications that may be brought to our attention by scientists in laboratories throughout the country. Organizations contemplating the use of depleted uranium or its compounds are invited to make such information available to the Battelle survey team."

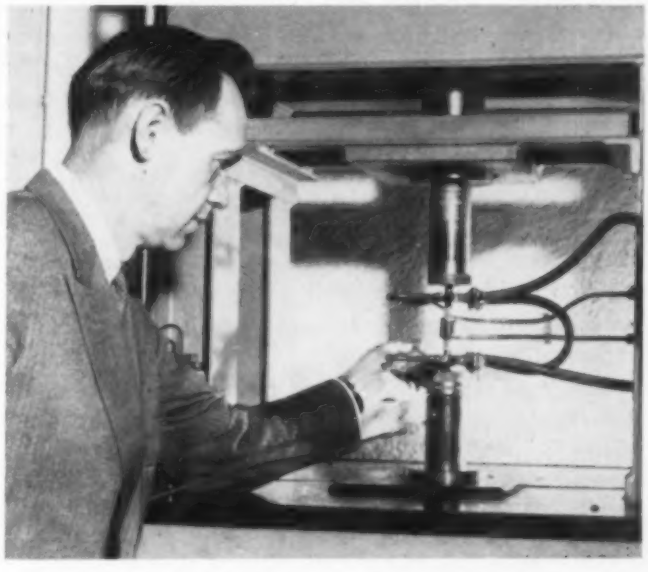
* FUEL-OIL-BURNER RESEARCH

The improvement of fuel-oil burners for home-heating units is a continuing interest of the petroleum industry. As an outgrowth of this interest, the American Petroleum Institute has announced that Battelle will undertake the planning of a research program looking toward improvement of existing oil-burner equipment and also development of new uses for fuel oil. The study, which is expected to continue for 12 months, will be supervised by the Fuel Oil Committee of API's Division of Marketing.

The research is being coordinated by D. W. Locklin of Battelle's Department of Mechanical Engineering. He is aided by Institute specialists in combustion physics, surface chemistry, catalysts, ceramics, plastics, metallurgy, and electrical controls. In the course of the study they will: survey current research activities; evaluate unconventional concepts in fuel-oil combustion; formulate an industry-wide research program believed necessary to meet the objectives of the API Fuel Oil Committee; and finally, help to open up communication with various segments of the oil-heating industry, pointing up areas requiring special study and stimulating interest in groups within the industry to do the necessary research on a coordinated basis.

In discussing the project, API President Frank M. Porter stated: "Principal emphasis will be directed to burners for residential space-heating and water-heating applications. However, burners for new uses for fuel oil also will be considered. Major criteria for evaluating combustion concepts and in planning burner research will be initial cost and reliability, as these are the factors of greatest influence on public acceptance and, therefore, on the competitive situation".

* STUDYING WELD FAILURES



From data provided by this apparatus, metallurgists are able to gain insight into failure in welds of high-strength steels. Such failures are caused chiefly by the cracking of the high-strength alloys used in such weldments. Cracking in welding usually occurs at temperatures 100 to 500 F below the melting temperature of the weld metal. Metallurgists study the phenomenon by simulating welding-temperature conditions, first melting and then allowing specimens to cool in the apparatus. During cooling, the strength and ductility of the specimen is evaluated at a selected temperature as it cools from about 2700 F. Welding metallurgist Perry J. Rieppel, who is examining the Battelle-designed and built apparatus, states that it has been used to study hot-piercing qualities of steels, relations between chemical composition and hot tearing of alloy steel castings, and welds in high-temperature iron and nickel-base alloys.

* METAL-CUTTING RESEARCH

Metal-cutting operations are so extensive that they play a part in the manufacture of most metal products. The industry has naturally supported extensive research over the years. While much of this effort has been of lasting benefit, leaders in the field believe that emphasis has been largely on "what" happens rather than on "why" it

happens. Therefore, the Research Fund of the American Society of Tool Engineers, recently sponsored a study to evaluate, analyze, and condense the lessons contained in the world's metal-cutting literature. This was planned as a first step in a long-range program of metal-cutting research.

A group of Battelle technologists, under the guidance of F. W. Boulger, studied the literature and prepared a *Report on An Evaluation of the Present Understanding of Metal Cutting*. Now published, this report covers such aspects of metal-cutting technology as the mechanism of chip formation, effect of normal stresses on shear flow strength, thermal and physical aspects of cutting, wear and life of tools, cutting fluids, and the influence of the properties of metals on cutting. In each instance, the most significant research is reviewed and placed in perspective to show the state of current knowledge.

Each part of the report concludes with a section that points up areas where knowledge is deficient and indicates research studies that would be valuable. The report itself concludes with a discussion of the approaches to research that would contribute to broader understandings in the field.

Copies of the report may be obtained from the American Society of Tool Engineers' Research Fund, 10700 Puritan Avenue, Detroit 38, Michigan.

* EVALUATING METAL STRENGTH

Usually, in evaluating the high-temperature strength of a material, metallurgists think in terms of the stress required to produce rupture in a certain number of hours—say 100 or 1000 or more. In view of the current interest in high-temperatures alloys, however, a more rapid method of evaluation is desirable. In the course of a study for the U. S. Air Force, Battelle metallurgist Ervin E. Underwood has developed a concept that permits rapid determination of the creep or tensile strength of high-purity alloys as well as complex commercial alloys.

The concept is based primarily upon the equivalence of the "equichohesive point" of a metal as determined by hot hardness, tensile, or creep tests. Normally there is a temperature which separates low-temperature deformation in metals (where fracture is through the grain) and high-temperature deformation (where fracture occurs at the grain boundaries of a metal). This equicohesive temperature has heretofore been qualitative because it varies with the speed of the test. Underwood has shown that by taking time effects into consideration, the equicohesive temperature becomes fixed.

This new equicohesive point has also been found to correlate with the high-temperature strengths and stabilities of alloys. Since strength is related to various basic properties of alloys, these new correlations can lead to better understanding of the basic mechanisms involved. These results appear to be a definite step toward the ultimate goal of prediction of alloy properties.

* The seventh Gillett Memorial Lecture, "The Role of Dislocations in Plastic Deformation (of Metals)", will be presented this month by Dr. John C. Fisher. Pertaining each year to the development, evaluation, or application of metals, the lecture commemorates Horace W. Gillett, first director of Battelle and one of the nation's leading metallurgists. It is sponsored jointly by the American Society for Testing Materials and Battelle and will be presented on June 24 during the ASTM's 62nd Annual Meeting at Atlantic City, New Jersey.

Dr. Fisher, an authority in the fields of metal physics and research analysis, is Physicist in the Physical Metallurgy Section of the Metallurgy and Ceramics Research Department of General Electric's Research Laboratories.

* Recent appointments of Battelle staff members to key technical posts: L. W. COFFER—chairman, High-Temperature Metals Committee, Extractive Metallurgy Division, American Institute of Mining, Metallurgical, and Petroleum Engineers; F. BENINGTON—member, Board of Directors, Cave Research Foundation, National Science Foundation; J. H. JACKSON—member, Committee on Metallic Materials, Materials Advisory Board, Division of Engineering and Industrial Research, National Academy of Science—National Research Council; L. R. JACKSON—member, Committee on National Requirement Criteria for Advanced Design, Materials Advisory Board, NAS-NRC; A. W. LEMMON, JR.—General Co-Chairman, Propellent Thermodynamics and Handling Conference (July, 1959, Ohio State University), American Rocket Society; D. A. VAUGHAN—member, Technical Group T-3 on General Corrosion, National Association of Corrosion Engineers.

Writings by STAFF Members

Cobalt, March, 1959, contains the following articles by staff members:

Alloys for the Aircraft Industry. The Role of Cobalt. F. R. Morral, pp. 23-26.

Generally, the cobalt-base alloys find use above 1600 F and at low stress for short periods of time up to 2200 F.

Cobalt Oxides as Catalysts. Herbert Schachner, pp. 37-40.

Cobalt oxides offer good prospects as materials for catalytic afterburners for motor exhaust gases: in the present state of development they show a conversion efficiency af almost 100 per cent of organic material and carbon monoxide to carbon dioxide and water for approximately 100 hours before having to be renewed.

Ultrasonic Atomization of Liquids. John N. Antonevich. *IRE Transactions on Ultrasonics Engineering, PGUE-7*, February, 1959, pp. 6-15.

Films atomized under ultrasonic excitation, and by rupture of capillary waves in the film are suggested as the prime cause of atomization. High-speed motion pictures show sprays emanating from vibrating gas bubbles in the paint film. The particles produced were from 5μ to 500μ in diameter. Under the best atomizing conditions at 20 kc, the particle diameters were from 20μ to 70μ.

Realistic Temperature-Power Derating Requirements for Carbon-Composition Resistors. J. L. Easterday and H. Braner. *Electrical Manufacturing*, March, 1959, p. 141 + 5 pages.

Weaknesses of derating curves in MIL specifications and manufacturers' literature are discussed, and two new methods are described and statistically analyzed. The first method indicates degradation of the resistor at high temperature in terms of the deviation of the resistance from the initial value as a function of load for a life of 2000 hours; the second method indicates the derating requirements for a maximum of 20 per cent resistance deviation from nominal during 2000 hours of life.

Titanium Alloys Today. Paul D. Frost. *Metal Progress*, March, 1959, pp. 95-98.

Though the glamour is wearing off, titanium is definitely being established as a useful structural material. It is light, strong, and temperature resistant. Through alloy additions, either alpha or beta phase can be stabilized. Heat treatments, much like those used for steels, enhance the mechanical properties, particularly those of the alpha-beta and beta alloys. This review of alloying behavior and heat treatment should promote a better understanding of commercial alloys. Property data are provided in the Data Sheet.

Recent Survey of Current Activities on Fatigue. Horace J. Grover. *ASTM Bulletin*, January, 1959, pp. 26-29.

A report of subcommittee III on survey of ASTM committee E-9 concerning recent activities in the field of fatigue. Copies were sent to approximately 180 universities, research institutes, government laboratories, and industrial laboratories known to be interested in the field. About 50 laboratories reported some 161 programs under way. The titles of these projetcs are listed.

Members of the Battelle staff are authors of the recently published articles and books listed on these pages. In most cases, reprints are available from the Battelle Publications Office, 505 King Avenue, Columbus 1, Ohio.

Plastics Engineering 1957-1958. A Review of Developments. R. I. Leininger and R. A. Clark. *Mechanical Engineering*, March, 1959, pp. 54-57.

A review of developments in materials including polyethylene, polypropylene, polystyrene, acrylates, phenolics, polyesters, fluorocarbons, polyethylene oxide; polycarbonates, polyformaldehyde, and polyurethanes; new products including plastic fibers and containers, plastic pipe, reinforced plastics, foamed plastics and adhesives; and engineering properties.

The Diffusion of Oxygen in Alpha and Beta Zircaloy-2 and Zircaloy-3 at High Temperatures. M. W. Mallett, W. M. Albrecht, and P. R. Wilson. *Electrochemical Soicety, Journal*, March, 1959, pp. 181-184.

Diffusion rates were determined in the range 1000 degrees to 1500 degrees centigrade. Spot checks of the diffusion of oxygen in alpha and beta Zircaloy-3 to 1100 degrees and 1400 degrees centigrade show that the rates are in close agreement with those for oxygen in Zircaloy-2. The diffusion coefficients for oxygen in beta Zircaloy-2 and Zircaloy-3 are about 10 times greater than those for nitrogen in high-purity beta zirconium.

Are Metallic Meteorites a Key to the Re-Entry Problem? R. E. Maringer and G. K. Manning. *Iron Age*, April 9, 1959, pp. 93-96.

Even the fastest missile seems relatively sluggish when compared to the cruising speed of the average meteorite. Metallic meteorites help to spell out the magnitude of high-velocity space travel—especially the re-entry problem. Here are some of the interesting facts they have to tell. The microstructure of the Grant meteorite shows a prevalence of alpha iron. These grains are surrounded by white bands of gamma iron. Aerodynamic heating causes microstructural changes in metallic meteorites. Above are changes noted in Costilla Peak meteorite. Such changes can be simulated with laboratory heat treating equipment. A lamellar deposit appears on the trailing edge of the Costilla Peak meteorite. Metal froze where aerodynamic heating was milder. From the standpoint of aerodynamic design, irregularly shaped, iron-nickel meteorites leave a lot to be desired. Far more appropriate materials could be chosen for high velocity re-entry. But meteorites still contribute by underlining the severity of the problem with which our designers are faced.

Gray Cast Iron Machinability. Quantitative Measurements of Pearlite and Graphite Effects. W. W. Moore and J. O. Lord. *Modern Castings*, April, 1959, pp. 55-60.

Common types of unalloyed cupola-melted gray cast iron were studied to determine how changes in some of the major constituents of their microstructures affected machinability. The objective of the study was to make a contribution to the understanding of fundamental and basic factors affecting the machining ease of gray cast iron.

Study of Plastic Deformation in Binary Aluminum Alloys by Internal-Friction Methods. E. C. Olson, R. E. Maringer, L. L. Marsh, and G. K. Manning. *U. S. National Aeronautics and Space Administration, NASA Memorandum* 3-3-59W, March, 1959, 31 pp.

The damping capacity of several aluminum-copper alloys has been investigated during tensile elongation. This damping is shown to depend on strain rate, strain, temperature, alloy content, and heat treatment. A tentative hypothesis, based on the acceleration of solute atom diffusion by deformation-produced vacancies, is proposed to account for the observed behavior. Internal-friction maxima are observed in deformed aluminum and aluminum-copper alloys at −70 and −50 C. The peaks appear to be relatively insensitive to frequency and alloy content, but they disappear after annealing at temperatures nearing the recrystallization temperature.

Fluidized Beds for Metal Production. J. H. Oxley and I. E. Campbell. *Journal of Metals*, v. 11, February, 1959, pp. 135-137.

Metal production by vapor deposition in a fluidized bed has been the result of applying the chemistry of vapor plating to the engineering involved in handling fluidized solids. Commercial possibilities depend on availability of low-cost feeds.

(next page)

Adhesive Bonding of Titanium. H. E. Pattee, G. E. Faulkner, and P. J. Rieppel. *Materials in Design Engineering*, v. 49, February, 1959, pp. 96-99.

Two of the many problems that have tended to slow the development of adhesive-bonded titanium structures are: 1) the unavailability of adhesives that can be used at elevated temperatures for long periods of time, and 2) the unavailability of suitable surface treatments to prepare titanium for bonding. In addition, the use of titanium core materials will necessitate some changes in manufacturing techniques and tools in adhesive bonding. Adhesive blends are best, but they do not solve all problems. The adhesive blends are combinations of thermoplastic, thermosetting and elastomeric adhesives which are formulated to obtain the optimum characteristics of each type. The most promising of the presently available adhesives are modified phenolic-epoxy resins. Much effort, however, is being exerted to develop high temperature ceramic, organic and semi-organic adhesives.

What Determines Engine Oil Consumption? M. Pobereskin, D. N. Sunderman, and E. J. Fithian. *Atomic World*, March, 1959, pp. 110-111.

Radioactive tracers were added to diesel engine lubricating oil so that when the oil was burnt in the cylinders the activity woud pass into the exhaust gases. By monitoring the activity in the exhaust, it was possible to determine the oil consumption. A correlation between oil consumption and engine wear was made. Effect of running conditions on consumtpion was determined.

Savings Through Material Control. James B. Purdy. *Tool Engineer*, April, 1959, pp. 97-101.

Cost control of purchased semifinished and raw materials can be a fertile field for savings. The author lists factors to watch and examines them in detail for various kinds of materials. In general, the more complex a product is, the smaller the influence of materials on total value. The manufacturing industries listed were chosen to illustrate industries where materials represent both high and low percentages of total product value.

Progress on Alloy Plating. I. Tungsten and Molybdenum Alloys. William H. Safranek and Luther E. Vaaler. *Plating*, v. 46, February, 1959, pp. 133-143.

Iron, cobalt, and nickel appear to be the only alloying elements that make possible the codeposition of substantial amounts of tungsten or molybdenum. Alloys of other metals can be produced, but very high current densities are required and current efficiency is very low. Both compositions and conditions are tabulated.

Effects of High Strain Rates and Rapid Heating on the Tensile Properties of Titanium Alloys. F. Schwartzberg. *Light Metal Age*, v. 17, February, 1959, pp. 11-12.

It has been shown by numerous investigators that strength properties tend to increase with increasing strain rate. Most researchers have ignored the effects of rapid heating, however. In order to properly assess the usefulness of materials under these conditions, special testing techniques must be used. Two organizations, Southern Research Institute and Marquardt Aircraft Company, have developed equipment for high-speed testing after rapid heating and have been evaluating various structural materials. Following generalizations to be drawn: 1. Yield and tensile strength increasing strain rate; this behavior is most pronounced at temperature above the present service limits of the subject alloys. Retention of strength to higher than normal temperatures can be achieved by testing at very high strain rates. 2. Ductility generally decreases with increasing strain rate. 3. Modulus of elasticity is not significantly affected by strain rate. 4. Holding time has no effect on tensile properties of titanium alloys annealed to a stable condition, except for losses in ductility due to surface oxidation at extremely high temperatures.

Vibration Drilling Gets Further Study. Ralph Simon. *Drilling*, v. 20, February, 1959, p. 110.

Drilling by vibration is accomplished by superimposing longitudinal vibrations onto the drill bit of an otherwise conventional rotary drilling system. A number of laboratory and field models of vibratory drilling machines have been designed, constructed, and used in experimentation. The latest version encompasses a magnetostriction transducer that follows a 10⅝-inch rotary bit down the hole. It is tentatively concluded that vibratory drilling in rock of medium hardness may be just about economically competitive with conventional drilling.

Refractory-Metal Thermocouples Containing Rhenium. Chester T. Sims, Gordon B. Gaines, and Robert I. Jaffee. *Review of Scientific Instruments*, v. 30, February, 1959, pp. 112-115.

The thermoelectric force developed by the following junctions up to 2200 C was measured: Re *vs* W, Re *vs* Mo, Re *vs* W–30Re, and Re *vs* Mo–50Re. The thermoelectric force for W *vs* W–30Re and Mo *vs* Mo–50Re was calculated. The Re *vs* W junction develops about 15 mv at 1000 C and may be usable up to 2600 C. The calculated outputs of W *vs* W–30Re and Mo *vs* Mo–50Re are high; the W *vs* W–30Re output is nearly linear over a wide range in temperature, and the thermocouple should be useful to about 2600 C. All of these couples must be used in vacuum or in neutral or reducing atmospheres.

Ductility and Strength of High-Carbon Gray Irons. E. M. Stein and H. O. McIntire. *Modern Castings*, v. 35, March, 1959, pp. 103-110.

Composition, microstructure and inoculation effects on ductility and strength of high-carbon (3.5-4.5%) cast irons were evaluated. Irons melted by cupola, induction and blast furnace were included in the study. Some of the cupola and induction-melted irons were inoculated with ferrosilicon or with proprietary inoculating agents. The criterion of ductility was the total elongation (or total strain) reached before fracture. Strain was measured with Sr-4 gases cemented to standard tensile specimens. Inoculation of low-manganese (0.3-0.5%) irons produced up to 50% increase in elongation, but the effect of inoculation decreased with increasing manganese content. Ductility was not affected significantly by a wide variation in silicon content and the associated variation in microstructure. For induction-melted and cupola irons, a relatively close relationship was found between carbon equivalent and strength, but the strength of the blast-furnace irons was considerably higher than this relationship would suggest. Increasing the Mn content above 0.5% markedly increased the tensile strength through the associated increase of pearlite. Tensile strength was not affected by inoculation beyond the normal decrease from the increased silicon. There was a reasonably close correlation between hardness and strength for all of the irons.

Physical Simulation of a Variable-Reflector Reactor. J. J. Stone, Jr., B. B. Gordon, and R. S. Boyd. *Nucleonics*, v. 17, February, 1959, pp. 93-96.

A scheme for controlling a boiling-water reactor uses the steam pressure in the reactor pressure vessel to vary the height of the water reflector surrounding the core. As the steam pressure increases, the reflector height decreases. Thus, as the steam load varies, the reactor power level follows the load changes. By means of combined hydraulic and electronic simulation, the positioning of baffle plates in hydraulic coupling is shown to give the desired control.

Methods for End Capping Zirconium-Clad Reactor Fuel Pins. J. J. Vagi, R. L. Koppenhofer, and D. C. Martin. *Welding Journal*, v. 38, February, 1959, pp. 78S-84S.

Development program indicates that best seal is obtained by using a fuel pin in which the core is recessed to receive an end-cap insert that is attached and sealed by arc welding.

Preparation of Iodide Thorium. N. D. Veigel, E. M. Sherwood, and I. E. Campbell. Paper from "The Metal Thorium", pp. 104-113. 1958. American Society for Metals, Cleveland.

Describes the van Arkel-de Boer process which has proved to be a satisfactory method of producing high-purity thorium for experimental purposes. The relatively low as-deposited strength of iodide thorium places a limitation on the size of the crystal bars that can be produced.

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AERONAUTICAL ENGINEERING

6114* The Ground Effect on the Jet Flap in Two Dimensions. Experimental results included for the change of lift and pitching moment for several jet-deflection angles, with a limited investigation into the downwash changes behind the model. A provisional assessment of the performance of a jet-flap aircraft near the ground is made, and shows that for 58.1° jet-deflection angle there is a definite limit to the minimum flying speed for any given distance of the wing from the ground. An attempt is made to provide a theoretical explanation of the critical condition of blockage underneath the aerofoil. ***D. J. Huggett.*** *Aeronautical Quarterly*, v. 10, pt. 1, Feb. 1959, p. 28-46.

6115* Supersonic Flow Past Slender Pointed Wings With "Similar" Cross Sections at Zero Lift. The wings considered may have any pointed plan form shape, provided that the trailing edge is straight and unswept. The root section profile and cross-section shapes are arbitrary, provided that, on any one wing, the latter are "descriptively similar" (diamond or parabolic biconvex for instance), though not necessarily geometrically similar. The chief aim of the work is to find wings with simple geometry, low wave drag and pressure distributions which were unlikely to be seriously affected by viscous effects. ***W. T. Lord and G. G. Brebner.*** *Aeronautical Quarterly*, v. 10, pt. 1, Feb. 1959, p. 79-102.

6116* 1959 Missile Handbook. United States missile projects, missile directory and data, space programs, and directory of contractors. ***Kendall K. Hoyt.*** *Aircraft and Missiles Manufacturing*, v. 2, Mar. 1959, p. 19-64.

6117 The Analysis of Fuselages of Arbitrary Cross-Section and Taper. I. General Theory. Presents method for the structural analysis of stressed skin fuselages for application in conjunction with the digital computer. The matrix force method permits a close integration of the analysis and the programming for a computer operating with a matrix interpretive scheme. The structural geometry covered by the analysis is sufficiently arbitrary to include most cases encountered in practice, and allows for nonconical taper, double-cell cross-sections, and doubly connected rings. ***J. H. Argyris and S. Kelsey.*** *Aircraft Engineering*, v. 31, Mar. 1959, p. 62-74.

6118 The Nature of Re-entry. Interaction of re-entry body and weapon system design; peak heat rate; re-entry in terms of payload, dispersion, and effectiveness. ***George E. Solomon.*** *Astronautics*, v. 4, Mar. 1959, p. 20 + 3 pages.

6119 Re-entry Heat Transfer. Mass-addition effect on heat-transfer rate; heat transfer by radiation; analysis of ablation process; use of subliming material. ***Lester Lees.*** *Astronautics*, v. 4, Mar. 1959, p. 22 + 4 pages.

6120 Hypersonic Aerodynamics. I. Trajectories for high-speed vehicles; use of booster; range performance; effect of aerodynamic cleanness. ***Wallace D. Hayes.*** *Astronautics*, v. 4, Mar. 1959, p. 24 + 3 pages.

6121 Heat Protection for Re-entry Vehicles. Heat transfer to vehicle; safety factors; protection of insulation. If aerodynamic drag is used to slow the re-entering vehicle, velocities are limited to 50,000 fps. ***Norris F. Dow.*** *Astronautics*, v. 4, Mar. 1959, p. 28 + 4 pages.

6122* The Use of Models in Aeroelastic Analysis. Development of experimental methods to supplement analytical work is reviewed and some examples presented. Theory of aeroelastic model design; types of models required for different applications. Model construction, instrumentation, and test techniques are presented and some conclusions are derived regarding the role played by aeroelastic models in the design process. ***J. A. McKillop.*** *Canadian Aeronautical Journal*, v. 5, no. 3, Mar. 1959, p. 89-98.

6123 Fundamentals of Advanced Missiles. Kinematics of flight; application of fluid mechanics to aerodynamics and propulsion; dynamics; some applications of probability and statistics; properties of microwaves; application of infrared radiation; radar; guidance; guided missile systems. ***Richard B. Dow.*** 567 pp. 1958. John Wiley & Sons, New York. (UG630 D75f)

6124 High Temperature Effects in Aircraft Structures. Materials for high-temperature aircraft structures; heat transmission; creep and relaxation in metals and plastics; fatigue of structural materials; thermal stresses and buckling; stress distribution and creep buckling; influence of aerodynamic heating on aeroelastic phenomena; experimental methods. ***Nicholas John Hoff, editor.*** 357 pp. 1958. Pergamon Press, New York. (TL671.1 H67h.)

6125 Pressure Distributions on Blunt-Nosed Cones in Low Density Hypersonic Flow. Effect of viscous interactions on surface pressures of models. ***L. Talbot, S. A. Schaaf, and F. C. Hurlbut.*** *Jet Propulsion,* v. 28, Dec. 1958, p. 832-834.

6126 Some Comments on Generalized Trajectories for Free Falling Bodies of High Drag. Analysis and graphical solutions. Numerical values for trajectory analysis. Presents a curve for rapid calculation of descent through an exponential atmosphere. ***William Squire.*** *Jet Propulsion,* v. 28, Dec. 1958, p. 838-839.

6127* Some Significant Developments in Aerodynamics Since 1946. Wing theory—slender wings and aircraft, interference effects, aeroelastic theories. Nonlinear theories—higher-order approximations, transonic flow, hypersonic flow, boundary-layer theory, theory of turbulence. ***Theodore von Kármán.*** *Journal of the Aero/Space Sciences,* v. 26, Mar. 1959, p. 129-142.

6128* Direct-Analog Method of Analysis of the Influence of Aerodynamic Heating on the Static Characteristics of Thin Wings. General method of analysis of temperature effects on structures is presented. The method is then applied to the example of a square, cantilever, constant-depth wing box, which is symmetrically heated along the leading and trailing edges. The electric analog computer is used to calculate the thermal in-plane stresses and the lateral load influence coefficients. Results are compared for the heated and unheated wing. ***Michael A. Basin, Richard H. MacNeal, and John H. Shields.*** *Journal of the Aero/Space Sciences,* v. 26, Mar. 1959, p. 145-154.

6129* Investigation of Normal Force Distributions and Wake Vortex Characteristics of Bodies of Revolution at Supersonic Speeds. Results of wind-tunnel tests, whereby the normal force, pitching moment, normal force distributions, and the local flow properties in the vicinity of the body were determined, are discussed and analyzed. Circulation strengths of the concentrated vortices and the circulation strengths of the vortex feeding sheets in the body vortex wake are determined by closed-countour velocity-perimeter integrations for paths enclosing the vortex or the feeding sheet. The complete vortex wake flow may be adequately predicted for a body of revolution, provided that the distribution of the viscous normal force and the vortex locations are accurately known. ***J. F. Mello.*** *Journal of the Aero/Space Sciences,* v. 26, Mar. 1959, p. 155-168.

6130* On the Flow of a Sonic Stream Past an Airfoil Surface. Analysis of the Mach wave pattern suggests that the supersonic domain of the flow can be derived from two simple-wave flows, one arising from the Mach waves reflected at the sonic line and the other from the changes in airfoil surface slope. The compressive effect of the reflected Mach waves is determined quantitatively as a function of airfoil leading-edge geometry from an analysis of measured pressure distributions for uncambered airfoils; and it is shown how this can be superimposed on the wave system from the curved surface to give an equivalent simple-wave flow over the airfoil. ***Colin S. Sinnott.*** *Journal of the Aero/Space Sciences,* v. 26, Mar. 1959, p. 169-175.

6131* On the Base Pressure Resulting From the Interaction of a Supersonic External Stream With a Sonic or Subsonic Jet. It is shown that the two-dimensional base pressure problems relating to base bleed into the wake of blunt-trailing-edge airfoils, or the interaction between an external supersonic or sonic slipstream with a sonic or subsonic jet stream of a jet engine, can be calculated by theoretical considerations. Constant-pressure, isoenergetic, turbulent mixing between the streams and the stagnant fluid in the wake is assumed. ***W. L. Chow.*** *Journal of the Aero/Space Sciences,* v. 26, Mar. 1959, p. 176-180.

6132 The Aircraft Structural Factor of Safety. Presents the case for a review of the Aircraft Structural Factor of Safety in the light of appreciable advancements in structural and aerodynamic knowledge. In certain design aspects, a reduction in the presently required ultimate factor of safety is realistic. ***George N. Mangurian.*** *North Atlantic Treaty Organization, AGARD Report No.* 154, Nov. 1957, 24 pp. (TL565 Ag11r Vis.)

6133 Principles of Guided Missile Design. Operations Research, Armament, Launching. Underlying principles of guided missile technology; devices and techniques employed to guide missiles. ***Grayson Merrill, Harold Goldberg, and R. H. Helmholz.*** 508 pp. 1956. Van Nostrand, Princeton, N. J. (UG630 M55p)

6134 On the Problem of Cooling Atomic Rockets Which Utilize Thermonuclear Reactions. Shows that a suitable modification of Oberth's "Schleierkuhlung" (screen cooling) is adequate at extremely high temperatures, such as appear in atomic jet engines and that an adequate cooling capacity at extremely high temperatures may be expected. ***R. L. Bjork.*** *Rand Corporation, Translation T-53,* Nov. 1, 1955, 39 pp. (From "The International Congress on Aeronautics, Proceedings—4th Congress, Zurich, 1953".) Rand Corporation, Santa Monica, Calif.

6135 The Russian Atomic Airplane of the Future. *F. J. Krieger.* *Rand Corporation, Translation T-55,* Jan. 26, 1956, 7 pp. (From *Tekhnika-Molodezhi (Technology for Youth),* August 1955.) Rand Corporation, Santa Monica, Calif.

6136 Vanguard I IGY Satellite (1958 Beta). Instrumentation used, measurements obtained, and uses of the Vanguard I satellite. Satellite contains two transmitters, one powered by batteries and one powered by solar cells. From the transmitted frequencies temperature information and rotation rates are obtained. The transmitted signals are also used to determine the satellite orbit. ***R. L. Easton and M. J. Votaw.*** *Review of Scientific Instruments,* v. 30, Feb. 1959, p. 70-75.

6137 Rocketry and Space Exploration. Rockets and how they operate; rocketry in the 1930's; Axis and Allied war rockets; the war's heritage; post-war rocketry in America; working societies. ***Andrew G. Haley.*** 334 pp. 1958. Van Nostrand, Princeton, N. J. (TL782 H13r)

6138 Space Handbook: Astronautics and Its Applications. Space environment; trajectories and orbits; rocket vehicles; propulsion systems; propellants; structures and materials; guidance; communication; observation and tracking; landing and recovery; environment of manned systems; space stations and extraterrestrial bases; nuclear weapon effects in space; other technology and applications. 252 pp. 1959. United States Government Printing Office, Washington, D. C. (TL790 Un3.31s)

6139 A Three-Dimensional Flow Expander as a Device to Increase the Mach Number in a Supersonic Wind Tunnel. A preliminary investigation of a simple 5° conical-flow expander was made to determine the feasibility of using this type of device to increase the Mach number in the test section of a supersonic wind tunnel. The inlet-to-exit area ratio of the nozzle was that required to increase one-dimensional flow from a Mach number of 3.88 to 5.5. The Mach numbers obtained at the expander exit varied from about 5.1 at the centerline to about 5.4 near the walls. No difficulty in operation of the main wind tunnel was experienced. ***Reino J. Salmi.*** *U. S. National Aeronautics and Space Administration, NASA Memorandum* 10-6-58E, Dec. 1958, 7 pp. (TL782 Un3rm Vis.)

6140 Heat Transfer in the Turbulent Incompressible Boundary Layer. I. Constant Wall Temperature. II. Step-Wall-Temperature Distribution. III. Arbitrary Wall Temperature and Heat Flux. IV. Effect of Location of Transition and Prediction of Heat Transfer in a Known Transition Region. ***W. C. Reynolds, W. M. Kays, and S. J. Kline.*** *U. S. National Aeronautics and Space Administration, NASA Memorandum* 12-1-58W, 12-2-58W, 12-3-58W, 12-4-58W; Dec. 1958, 36 pp; 38 pp; 52 pp; 28 pp. (TL782 Un3rm Vis.)

6141 An Analysis of Flight-Test Measurements of the Wing Structural Deformations in Rough Air of a Large Flexible Swept-Wing Airplane. An analysis is made of wing

deflection and streamwise twist measurements in rough-air flight of a large flexible swept-wing bomber. Random-process techniques are employed in analyzing the data in order to describe the magnitude and characteristics of the wing deflection and twist responses to rough air. Power spectra and frequency-response functions for the wing deflection and twist responses at several spanwise stations are presented. ***Harold N. Murrow.*** *U. S. National Aeronautics and Space Administration, NASA Memorandum* 12-3-58L, Jan. 1959, 46 pp. (TL782 Un3rm Vis.)

6142 Three-Dimensional Orbits of Earth Satellites, Including Effects of Earth Oblateness and Atmospheric Rotation. Complete trajectories of earth satellites were studied from outer space to the ground using automatic computation. Equations of motion based on an "instantaneous ellipse" method were found suitable for automatic computation up to the terminal phase of the trajectory. For the terminal phase, equations of motion using time as an independent variable were found more suitable. Several sample calculations were performed to study the effect of the earth's oblateness and the atmosphere's rotation on the motion and the point of impact. ***Jack N. Nielsen, Frederick K. Goodwin, and William A. Mersman.*** *U. S. National Aeronautics and Space Administration, NASA Memorandum* 12-4-58A, Dec. 1958, 83 pp. (TL782 Un3rm Vis.)

6143 Free-Flight Investigation of a Rocket-Propelled Model to Determine the Aerodynamic Heating on a Thin, Unswept, Untapered, Multispar, Aluminum-Alloy Wing at Mach Numbers Up to 2.22. Effects of aerodynamic heating on structural behavior of a wing at supersonic speeds. The test wing was a thin, unswept, untapered, multispar, aluminum-alloy wing having a 20-inch chord, a 20-inch exposed semi-span, and a circular-arc airfoil section with a thickness ratio of 5 per cent. The wing was tested on a model propelled by a two-stage rocket-propulsion system to a Mach number of 2.22 and a corresponding Reynolds number per foot of 13.2×10^6. ***Emily W. Stephens.*** *U. S. National Aeronautics and Space Administration, NASA Memorandum* 12-15-58L, Jan. 1959, 38 pp. (TL782 Un3rm Vis.)

6144 The Effect of Leading-Edge Sweep and Surface Inclination on the Hypersonic Flow Field Over a Blunt Flat Plate. Surface pressures were measured on blunt flat plates with various values of angle of attack and of leading sweep for Mach numbers of 4 and 5.7 and Reynolds numbers per inch of 6,600 and 20,000. Surface pressures were correlated for a wide range of variables by a method developed from boundary-layer and blast-wave theory. Boundary-layer thicknesses and shock-wave locations were determined from flow-field surveys. A method was developed to predict the variation in local Reynolds number with leading-edge sweep. ***Marcus O. Creager.*** *U. S. National Aeronautics and Space Administration, NASA Memorandum* 12-26-58A, Jan. 1959, 45 pp. (TL782 Un3rm Vis.)

6145 Effects of Large Wing-Tip Masses on Oscillatory Stability of Wing Bending Coupled With Airplane Pitch. An examination of oscillatory wing-bending stability for a straight-winged airplane with large concentrated wing-tip masses was made using wing-bending and airplane-pitching degrees of freedom and considering only quasi-steady aerodynamic forces. It was found that wing-bending instability caused by coupling of airplane pitching and wing-bending dynamics occurred. Actual conditions for this instability are given in terms of a number of dimensionless quantities which describe the airplane and its flight condition. ***Donald T. Higdon.*** *U. S. National Aeronautics and Space Administration, NASA Memorandum* 12-29-58A, Jan. 1959, 32 pp. (TL782 Un3rm Vis.)

6146 A Weight Comparison of Several Attitude Controls for Satellites. Results showed that a control for one axis can be devised which will weigh less than 1% of the total weight of the satellite. The inertia-wheel system offers weight-saving possibilities if a large number of cycles of operation are required, whereas the jet system would be preferred if a limited number of cycles are required. The magnetic-bar control requires such a large magnet that it is impractical for the example application. ***James J. Adams and Robert G. Chilton.*** *U. S. National Aeronautics and Space Administration, NASA Memorandum* 12-30-58L, Feb. 1959, 19 pp. (TL782 Un3rm Vis.)

6147 Two-Dimensional, Supersonic, Linearized Flow With Heat Addition. Calculations are presented for the forces on a thin supersonic wing underneath which the air is heated. The analysis is limited principally to linearized theory but nonlinear effects are considered. It is shown that significant advantages to external heating would exist if the heat were added well below and ahead of the wing. ***Harvard Lomax.*** *U. S. National Aeronautics and Space Administration, NASA Memorandum*-1-10-59A, Feb. 1959, 35 pp. (TL782 Un3rm Vis.)

6148 Pressure Distributions at Transonic Speeds for Bumpy and Indented Midsections of a Basic Parabolic-Arc Body. Measured static-pressure distributions at the model surface and in the surrounding flow field are presented for a basic parabolic-arc body having a fineness ratio of 14 and for three additional bodies obtained by modifying the basic parabolic-arc body along the middle portion of the body length by adding a bump, by indenting, or by quadripole shaping. Data are subject to tunnel-wall interference and do not represent free-air conditions. ***Robert A. Taylor.*** *U. S. National Aeronautics and Space Administration, NASA Memorandum* 1-22-59A, Feb. 1959, 68 pp. (TL782 Un3rm Vis.)

6149 Parasite-Drag Measurements of Five Helicopter Rotor Hubs. The results indicate that, within the range of the tests, changes in angle of attack, hub rotational speed, and forward speed generally had only a small effect on the equivalent flat-plate area representing parasite drag. The drag coefficients of the basic hubs, based on projected hub frontal area, increased with hub area and varied from 0.5 to 0.76 for the hubs tested. ***Gary B. Churchill and Robert D. Harrington.*** *U. S. National Aeronautics and Space Administration, NASA Memorandum* 1-31-59L, Feb. 1959, 25 pp. (TL782 Un3rm Vis.)

6150* Topics in Dynamic Programming for Rockets. Programming of the thrust direction and of the thrust modulus with aerodynamic forces included, and in vacuum flight; maximum range in vacuum flight for the case where both the initial and final path inclinations are free and the velocity modulus at final point is also free. ***Angelo Miele and James O. Cappellari, Jr.*** *Zeitschrift für Flugwissenschaften,* v. 7, Jan. 1959, p. 14-21.

AGRICULTURE

6151 An Annual Review of World Production and Consumption of Fertilizers, 1957. Records and analyzes the production and consumption of nitrogen, phosphate and potash fertilizers in the world and in different continents and countries. ***H. J. Page.*** 89 pp. 1957. Food and Agriculture Organization of the United Nations, Rome. (S631 F73a Vis.)

6152* *Casca chinensis*, an Internal Parasite of California Red Scale. Review of the attempts to import and propagate *Casca chinensis.* Failures have been due to the particular, so far unknown, conditions necessary for reproduction of the male. Propagation experiments are described and new avenues of investigation are suggested. ***S. E. Flanders, J. L. Gressitt, and T. W. Fisher.*** *Hilgardia,* v. 28, no. 3, Nov. 1958, p. 65-91.

6153 Mineral Supplementation of Foods, Feeds. Discusses Ca, I, Cu, Mo, Co, Fe, Mn, Zn, Br, and Se as additives. ***W. R. Todd.*** *Journal of Agricultural and Food Chemistry,* v. 7, Mar. 1959, p. 166-173.

6154 Stability of Soil Crumbs. Suggests that both soil organic matter and soil conditioners increase the stability of soil crumbs by linking together the principal constituents of the crumbs, the domains of orientated clay, and the quartz particles. The linkages will be from the the surfaces of the quartz to either the external basal or external edge surfaces of the clay domains, forming inter-crystalline or peripheral complexes respectively. ***W. W. Emerson.*** *Nature,* v. 183, Feb. 21, 1959, p. 538.

6155 Radiation Protection and Free Radicals. Observations support the view that the protective effect of certain chemicals is due to direct action of the protective agent on

radiosensitive constituents, for instance, cell protein. ***Bernard Smaller and Eugene C. Avery.*** *Nature*, v. 183, Feb. 21, 1959, p. 539-540.

6156* The Effect of Growth-Regulating Substances on Disease Resistance and Plant Growth. A series of naphthalene-substituted aliphatic compounds varied in growth-regulating properties and in capacity to induce resistance to tomato wilt caused by *Fusarium oxysporum* f. *lycopersici*. 1-Naphthaleneacetic acid induced the greatest resistance; 4-(1-naphthyl)-butyric acid and its ethyl ester gave high resistance; and 3-(1-naphthoyl) propionic acid and its ethyl ester gave moderate resistance. Analogs with 4-carbon side-chains substituted in the 2 position induced only slight resistance. A working hypothesis is suggested that wilt resistance and inhibition of root elongation are physiologically related through modifications of plant pectic substances by growth regulators. ***Malcolm E. Corden and A. E. Dimond.*** *Phytopathology*, v. 49, Feb. 1959, p. 68-72.

6157* Isolation and Characterization of a Bacteriophage for *Corynebacterium flaccumfaciens*. From heavily infected seed material, specific phages were isolated for 2 important pathogenic organisms, *Corynebacterium flaccumfaciens* and *Xanthomonas phaseoli* var. *fuscans*. ***Z. Klement and B. Lovas.*** *Phytopathology*, v. 49, Feb. 1959, p. 107-112.

6158 Biological Control of Insect Pests. ***Charles A. Fleschner.*** *Science*, v. 129, Feb. 27, 1959, p. 537-544.

6159 Resistance to Sevin by DDT- and Parathion-Resistant Houseflies and Sesoxane as Sevin Synergist. The new carbamate insecticide, Sevin, has a low toxicity against houseflies. However, it is activated effectively by low concentrations of Sesoxane, a pyrethrum synergist. This occurs with normal nonselected flies and also with strains selected for resistance to DDT and Parathion, which have considerable cross resistance to Sevin. ***M. E. Eldefrawi, R. Miskus, and W. M. Hoskins.*** *Science*, v. 129, Apr. 3, 1959, p. 898-899.

BIOCHEMISTRY AND BIOPHYSICS

6160* Biological Control of Noxious Insects, Weeds. A number of cases are given where different biological agents are used, such as *Macrocentrus ancylivorus* against the oriental fruit moth, *Tiphia popilliavora* and *T. vernalis* against the grubs in the soil, *Polistes* wasps against the hornworm larvae on flue-cured tobacco. ***C. H. Hoffman.*** *Agricultural Chemicals*, v. 14, Mar. 1959, p. 47 + 2 pages.

6161* The Effect Produced by Anti-Cancerous Substances Upon Biochemical Mutants of Microorganisms With Disturbed Oxidation. "Degranol" does not slow down the growth of normal cultures of staphylococci and of the intestinal bacillus but does have a selective action on the growth of the biochemical mutants of these bacteria with disturbed oxidation. The mutant of *Bact. paracoli* was especially sensitive. A crystalline preparation of actinomycin C showed a high selective effect on the same staphyllococci and on bacilli. Antibiotic 6270 has the same action on *Bacillus mycoides*. (*In Russian.*) O deĭstvii protivorakovykh veshchestv na biokhimicheskikh mutantov mikroorganizmov s povrezhdennym okisleniem. ***G. F. Gauze, G. V. Kochetkova, and G. V. Vladimirova.*** *Akademiia Nauk SSSR, Doklady*, v. 124, no. 3, Jan. 21, 1959, p. 674-677.

6162* The Liver, Radiation and Leukemia. Chronic radiation effects on the liver result in the production of an alpha globulin which has a peculiar affinity for B_{12}. This protein gradually binds excessive amounts of vitamin B_{12} from the liver, or from an intestinal tract containing normal amounts of the vitamin. This excessive bound B_{12} is biologically active, resulting in abnormal production of nucleoproteins and excessive formation of immature cells. ***Marion F. Beard.*** *American Journal of Roentgenology, Radium Therapy and Nuclear Medicine*, v. 81, Mar. 1959, p. 504-508.

6163 Biochemical Engineering. Unit Processes in Fermentation. The present book is an expanded version of a course of ten post-graduate lectures on biochemical engineering by a group of experts at the Manchester College of Science and Technology in the spring of 1957. Some of the subjects treated were the following: principles, scope of biochemical engineering, micro-organisms, fermentation, sterilization of equipment, aerobic fermentations. ***R. Steel, editor.*** 328 pp. 1958. Macmillan, New York. (TP156.F4 St32b)

6164* Biochemical Differentiation in the Slime Mold. Study on an enzymic level of the metabolism of slime molds. An increased rate of carbohydrate synthesis is produced, that finally results in the accumulation of large amounts of cellulose. The authors investigated the successive steps by which the new pattern of substrates, enzymes, and products established itself. ***Barbara E. Wright and Minnie L. Anderson.*** *Biochimica et Biophysica Acta*, v. 31, no. 2, Feb. 1959, p. 310-322.

6165* Inactivation of Virus Nucleic Acid With Glyoxal Derivatives. Glyoxal and Kethoxal (β-ethoxy-α-keto-butyraldehyde) are shown to inactivate tobacco mosaic virus and its isolated nucleic acid, the free nucleic acid being inactivated at much lower reagent concentrations. The inactivation is compared with that of formaldehyde and it is concluded that in the intact virus also it is the reaction with the nucleic acid which leads to inactivation. ***Matthys Staehelin.*** *Biochimica et Biophysica Acta*, v. 31, no. 2, Feb. 1959, p. 448-454.

6166* The Role of Connective Tissue Proliferation in Invasive Growth of Normal and Malignant Tissues: A Review. Proliferation of underlying connective tissue is in all probability essential for invasion. Formation of young connective tissue around neoplasms may be important in many cases for invasive growth of malignant cells. The possible role of connective tissue proliferation and mechanisms of its development are briefly discussed. ***Ju. M. Vasiliev.*** *British Journal of Cancer*, v. 12, no. 4, Dec. 1958, p. 524-536.

6167* Observations on the Effects of Condensates From Cigarette Smoke on Human Foetal Lung *in Vitro*. All condensates increased the formation of new bronchioli and induced hyperplasia of the lining epithelium in individual bronchioli leading to partial or complete occlusion of the lumen. ***Ilse Lasnitzki.*** *British Journal of Cancer*, v. 12, no. 4, Dec. 1958, p. 547-552 + 2 plates.

6168* Impairment of Tumor Growth by Unnatural Amino Acids. Fourteen unnatural amino acids were assayed for their action on the development of a transplantable Novikoff hepatoma tumor, and 10 of them were found to exert some inhibitory effects. ***Fernand Martel and Louis Berlinguet.*** *Canadian Journal of Biochemistry and Physiology*, v. 37, Mar. 1959, p. 433-439.

6169* Localization of the Genetic Factors Responsible for the Kinetic Activity of X Chromosomes of *Drosophila melanogaster*. Chromosomes do not play a passive role in their progression to the poles. The measurable differences in kinetic activity are attributable to the constitution of the heterochromatic regions of the chromosome immediately adjacent to the centromere. ***D. L. Lindsley and E. Novitski.*** *Genetics*, v. 43, no. 6, Nov. 1958, p. 790-798.

6170* Participation of Bicarbonate in RNA and Protein Syntheses as Indicated by Virus Propagation in Human Cells. The suppressive effect of bicarbonate depletion on virus synthesis may be reversed by the addition of bicarbonate, adenosine, guanosine, cytidine, uridine or adenylic, guanylic, cytidylic, and uridylic acids, or enzymatically degraded RNA to the bicarbonate-depleted cultures. ***R. Shihman Chang.*** *Journal of Experimental Medicine*, v. 109, Mar. 1, 1959, p. 229-238.

6171* Immunologic Studies on Fertility and Sterility. II. Effects of Treatment of Semen With Antibodies on Fertility in Rabbits. Heifers were immunized with rabbit semen. The immune sera (IS) from them, in high concentrations, caused tail-tail agglutination of rabbit sperm in contrast to a head-head type produced by normal sera (NS). Diluted rabbit semen (same concentration for each trial) was mixed with NS and IS approximately 15 min. before being used for insemination. Normal serum did not affect fertilization. High concentrations of IS prevented fertilization but the fertilization rate increased as lower concentrations were used (173 females studied). The average embryo survival percentage for 58 IS

females was 38.2 compared to 53.1 for 59 NS females. The loss of whole litters was much more common in the IS group (23 females out of 58) than it was in the NS group (3 females out of 59). Resorbing embryos or placental sites were found in 17 of the 23 IS females. A significantly greater amount ($P < 0.005$) of embryonic death occurred in the IS group. ***C. A. Kiddy, W. H. Stone, and L. E. Casida.*** *Journal of Immunology*, v. 82, no. 2, Feb. 1959, p. 125-130.

6172* The Clearance of Antigen Antibody Complexes From the Blood by the Reticulo-Endothelial System. Soluble complexes of antigens with rabbit antibody interfere by a phenomenon of competition with the phagocytosis of carbon particles by the reticuloendothelial system, when injected intravenously into mice and rabbits. Evidence is presented that at least the larger soluble antigen-antibody aggregates are phagocytized by the Kupffer cells of the liver. The significance of these findings is discussed in relation to the localization of antigen-antibody complexes in the sites of pathologic lesions of serum sickness. ***B. Benacerraf, M. Sebestyen, and N. S. Cooper.*** *Journal of Immunology*, v. 82, no. 2, Feb. 1959, p. 131-137.

6173* The Hallucinogenic Mushrooms of Mexico: An Adventure in Ethnomycological Exploration. Includes an extensive and up-to-date bibliography. ***R. Gordon Wasson.*** *New York Academy of Sciences, Transactions*, v. 21, no. 4, Feb. 1959, p. 325-339.

6174* Indirect Inactivation of Macromolecules in Solution by Ionizing Radiation. A Method of Analysis. Establishes an improved method of treating indirect inactivation and provides criteria for discriminating between indirect and other types of inactivation. The criteria provide a means of differentiating mechanisms by which radiation interacts with biological material and of showing how these mechanisms and their associated probabilities are affected by pH and the ionic complement of the solvent. The linear relation predicted by this method is applicable at the lowest protein concentrations. ***Leroy Augenstine.*** *Radiation Research*, v. 10, no. 2, Feb. 1959, p. 89-111.

6175* Acquired Radioresistance. A Review of the Literature and Report of a Confirmatory Experiment. An experiment is reported which shows that for control adult female white Swiss mice, Walter Reed strain, the $LD_{50(30)}$ is 487 ± 25.7 r. If they are given 50 r WBR 10 days prior, it increases to 560 r ± 31.0 r; and if the interval is 17 days, it is 617 r ± 32.0 r. ***Michael P. Dacquisto.*** *Radiation Research*, v. 10, no. 2, Feb. 1959, p. 118-129.

6176* Effect of Thymectomy on Development of Leukemia in C3H Mice Inoculated With Leukemic "Passage" Virus. Thymectomy, either preceding, or following inoculation of leukemic passage. A filtrate, inhibits development of leukemia in otherwise susceptible C3H mice. ***Ludwik Gross.*** *Society for Experimental Biology and Medicine, Proceedings*, v. 100, no. 2, Feb. 1959, p. 325-328.

6177* Effect of Foreign Fetal and Newborn Blood-Forming Tissues on Survival of Lethally Irradiated Mice. Lethally irradiated mice that received blood-forming cells from homologous fetal liver showed better long-term survival and lymphatic tissue recovery, than those treated with blood-forming cells from adult homologous bone marrow. In both cases there was transplantation and persistence of erythropoietic cells. ***I. S. Urso, C. C. Congdon, and R. D. Owen.*** *Society for Experimental Biology and Medicine, Proceedings*, v. 100, no. 2, Feb. 1959, p. 395-399.

6178* Reduction of X-Radiation Mortality by Cabbage and Broccoli. Exposure to 400 r of whole-body X-radiation resulted in 100% mortality in 10 to 15 days of young male guinea pigs fed a basal diet of bran and oats plus ascorbic acid. Supplementation with cabbage or broccoli for 2 weeks before irradiation and during 30 days after irradiation significantly reduced mortality. Lyophilized cabbage retained ability to reduce radiation mortality. Pre-feeding of guinea pigs to time of radiation exposure significantly delayed onset of death and enabled some animals to survive test period. ***Harry Spector and Doris Howes Calloway.*** *Society for Experimental Biology and Medicine, Proceedings*, v. 100, no. 2, Feb. 1959, p. 405-407.

6179* Response of Ciliated Epithelia of Different Histological Origin to Virus Infections *in vitro*. Adult human and rabbit Fallopian tube fragments were submitted to infection with polio, adeno, bovine rhinotracheitis, herpes and other viruses. The organized ciliated epithelium when compared with dedifferentiated epithelium in the same cultures showed in all cases a relative resistance to the cytopathic action of viruses, manifested by a marked delay in cell destruction, more pronounced in the case of bovine rhinotracheitis or polio and less marked in the case of herpes or vaccinia viruses. ***Georges Barski, Francine Cornefert, and Roslyn E. Wallace.*** *Society for Experimental Biology and Medicine, Proceedings*, v. 100, no. 2, Feb. 1959, p. 407-411.

6180* Effects of Immunized Parental Strain Bone Marrow on Lethally Irradiated F_1 Hybrid Mice. Pre-sensitization of parental strain donor mice against F_1 hybrid recipients accentuated the foreign bone marrow reaction caused by injection of parental marrow cells into lethally irradiated F_1 recipients. This effect occurred with the use of parental strains (101 and C3H) that were histocompatible at the *H*-2 locus, as well as with those (C57BL and 101) that were histoincompatible at this locus. These results are interpreted to indicate the importance of relative antibody-forming potency of implanted cells, as well as the extent of histocompatibility differences in pathogenesis of the homograft reaction. ***G. E. Cosgrove, Jr., A. C. Upton, E. E. Schwartz, C. C. Congdon, and T. Makinodan.*** *Society for Experimental Biology and Medicine, Proceedings*, v. 100, no. 2, Feb. 1959, p. 417-420.

6181 Immunochemically Active Cross-Linked Polystyrene. "Distrene" was nitrated to give a product containing approximately 1 nitro group per styrene residue. The product was reduced to the polyamino compound. On diazotization in acid solution, it gave a very sparingly soluble diazonium salt. The suspension of the polydiazonium styrene was then coupled with the immune γ-globulin. The resulting cross-linked polymers, freed from protein, contained 20-30% of their weight of firmly bound protein. Improving the method by eliminating the sulfuric acid in the nitrating process, resulted, after proper treatment, in a final polymer with 60-70% of its weight of protein. Such "resins" have a degree of specificity in absorbing their respective antigens. ***L. H. Kent and J. H. R. Slade.*** *Nature*, v. 183, Jan. 31, 1959, p. 325-326.

6182 Anti-Thyroid Action of β-Aminoethyl*iso*thiouronium Dibromide in Rats. ***John Osmer, Robert B. Jennings, and Robert M. Dowben.*** *Nature*, v. 183, Feb. 14, 1959, p. 470.

6183 Antibody Formation by Isolated Spleen Cells Transferred to Recipients in Absence of Homotransplantation Reaction. Experiments revealed that the immaturity of the recipient does not affect the response of the transferred cells, but that the limiting factor is the homotransplantation reaction. When the transplantation reaction is eliminated by using transfer to embryos, the transferred cells form antibodies in large titers. Antibody formation was obtained even to protein antigens and thus a typical primary response was evoked. ***Z. Trnka and I. Riha.*** *Nature*, v. 183, Feb. 21, 1959, p. 546-547.

6184* Culture of Cell Suspensions of *Daucus carota*. Suspensions of individual cells of *Daucus carota* tissue were prepared. The growth of the cultures was examined after 45 days. In each culture the individual cells and their links outgrew their initial size by 22 to 27 times with increasing particle size and an easy settling of these particles. (*In German.*) Über die Kultur von Zellsuspensionen von *Daucus carota*. ***Ludwig Bergmann.*** *Naturwissenschaften*, v. 46, no. 1, Jan. 1959, p. 20-21.

6185* Structure and Function of the Nuclei of Animal Cells. (*In German.*) Struktur und Funktion der Kerne tierischer Zellen. ***Kurt Felix.*** *Naturwissenschaften*, v. 46, no. 2, Jan. 1959, p. 29-35.

6186* Amino-Acid Sequences in Proteins. Primary, secondary and tertiary structures of proteins; amino acid sequence in the insulin of cattle and in the ribonuclease molecule, the protein structure as a hereditary character. (*In German.*) Aminosäure-Sequenzen in Proteinen. ***Hans Tuppy.*** *Naturwissenschaften*, v. 46, no. 2, Jan. 1959, p. 35-43.

6187* Biochemistry of Receptors and Resistance Factors. The Capacity of Living Things to Resist Adverse Environmental Influences. A study of the variety of resistance in nature, its importance in medicine and agriculture, and a classification of the resistance phenomena according to the activity of the substances. (*In German.*) Biochemie der Rezeptoren und Resistenzfaktoren. Von der Widerstandsfähigkeit der Lebewesen gegen Einwirkungen der Umwelt. ***Richard Kuhn.*** *Naturwissenschaften*, v. 46, no. 2, Jan. 1959, p. 43-50.

6188* The Structure of Antigens and the Nature of Immunological Specificity. Definition of antigen, production of artificial chemospecific antigens, range of the determining groups in the antigen and of the reactive areas in the antibody, antigen-antibody reaction, explanation of the structure of some natural antigens. (*In German.*) Die Struktur der Antigene und das Wesen der immunologischen Spezifität. ***Otto Westphal.*** *Naturwissenschaften*, v. 46, no. 2, Jan. 1959, p. 50-60.

6189* The Effect of Homologous Tissue Extract Upon the Viability of Rabbit Spermatozoa. ***Alphonse F. Grinius.*** *Naturwissenschaften*, v. 46, no. 2, Jan. 1959, p. 81.

6190* Effect of Actinomycin C Against Malignant and Normal Epithelial Cells, Absence of Pantothenic Acid Relationship. In determining the effects of actinomycin C against HeLa cells, it was observed that for the initial cell number of 200,000/ml, the effect of the antibiotic at a concentration of 0.1 γ/ml was very distinct after 24 hours of incubation at 37 C, but with 0.05 γ/ml the action became prominent only after 28 hours. 0.1 γ/ml of actinomycin C had distinct toxic effect against human epithelial amniotic cells. ***Guru Pada Sen.*** *Naturwissenschaften*, v. 46, no. 2, Jan. 1959, p. 82.

6191* pCO_2 Inhibition of Normal and Malignant Growth. It is suggested that embryonic and malignant cells achieve the ability to grow continuously by using an adenosine triphosphate (ATP) generating system—glycolysis—that does not result in the production of CO_2. Embryonic cells lose this auxiliary system as they mature into adult cells, but cancer cells develop glycolytic potential as they become malignant. Evidence from several sources suggests that free CO_2 is a physiologically produced, nontoxic, reversible inhibitor of cell growth. ***W. F. Loomis.*** *U. S. National Cancer Institute, Journal*, v. 22, no. 2, Feb. 1959, p. 207-217.

6192* Grafted-Marrow-Rejection Mortality Contrasted to Homologous Disease in Irradiated Mice Receiving Homologous Bone Marrow. The early mortality, resulting from administration of homologous or heterologous marrow into mice irradiated in the high sublethal or midlethal dose range, is the result of the recovered ability of the host to reject the temporarily grafted marrow, whereas the delayed mortality, following good, early protection against otherwise lethal doses of irradiation with homologous or heterologous marrow, usually results from an immunologic reaction of the grafted marrow derivatives against the tolerant host. ***J. J. Trentin.*** *U. S. National Cancer Institute, Journal*, v. 22, no. 2, Feb. 1959, p. 219-228.

6193* An Evaluation of Some Genetic Factors Influencing Irradiation Protection by Bone Marrow. A study of the genetic factors influencing the grafting of bone marrow in lethally irradiated mice revealed that a single gene difference at the *H*-2 locus provided sufficient basis for the severe reaction of the secondary phase of the irradiation syndrome. The *H*-1 locus provided a variable reaction, while the *H*-3 locus produced no reaction. In the testing of 27 inbred-strain combinations, no combination was found in which good long-term survival was observed when the strains were of different *H*-2 phenotypes. Nine inbred-strain combinations in which the marrow donor and the recipient were of the same *H*-2 phenotype, either $H\text{-}2^b$ or $H\text{-}2^d$, were found to be compatible. ***Delta E. Uphoff and L. W. Law.*** *U. S. National Cancer Institute, Journal*, v. 22, no. 2, Feb. 1959, p. 229-241.

6194* Emotional and Other Selected Characteristics of Cigarette Smokers and Nonsmokers as Related to Epidemiological Studies of Lung Cancer and Other Diseases. Cigarette smokers marry more often, move more frequently, change jobs more often, are hospitalized more often, and participate in more sports than nonsmokers. Also, the parents of nonsmokers are more often foreign born than those of smokers. No differences were noted in birthplace, religion, education, present marital status, and proportion of lifetime spent in large cities. ***Abraham M. Lilienfeld.*** *U. S. National Cancer Institute, Journal*, v. 22, no. 2, Feb. 1959, p. 259-282.

6195* Mammalian Chromosomes *In Vitro*. X. Heteroploid Transformation in Neoplastic Cells. The populations *in vitro* at first showed a decrease in the number of s cells and an increase in 2s cells. Later, the proportion of the 2s group also decreased, and many cells with chromosome numbers in the 60's or low 70's appeared (the stage of spread of chromosome spectrum). Prolonged residence *in vitro* seemed to cause the cells to lose their transplantability and perhaps also malignancy. The cell strains finally failed to produce tumors when reintroduced into hosts. These hosts developed a certain degree of immunity against subsequent challenges of tumor cells *in vivo*. Cultivating tumor cells *in vitro* thus appeared to attenuate the virulence of the cells without causing them to lose their antigenicity. ***T. C. Hsu and Oleta Klatt.*** *U. S. National Cancer Institute, Journal*, v. 22, no. 2, Feb. 1959, p. 313-339.

6196* Influence of Brain Ganglioside Upon the Neurotoxic Effect of Influenza Virus in Mouse Brain. Neurotoxic effects are decreased. ***Samuel Bogoch, Patricia Lynch, and Alvin S. Levine.*** *Virology*, v. 7, no. 2, Feb. 1959, p. 161-169.

CERAMICS AND CONCRETE

6197 A Method of Test for Potential Efflorescence of Masonry Mortar. Method of test is intended to determine quantitatively the potential efflorescence of mortar for unit masonry by measuring the water-soluble salts picked up by a ceramic wick imbedded in the mortar under prescribed conditions. The method may be used to test mortar either as proportioned and prepared in the laboratory or as prepared for use on the job. Efflorescence may be caused by water-soluble salts coming from any of the components making up the masonry or by atmospheric pollution. The occurrence of efflorescence depends on many factors other than the composition of the mortar. ***P. L. Rogers.*** *ASTM Bulletin*, no. 235, Jan. 1959, p. 31-33.

6198 Extending Concrete Highway Durability and Light Reflectance With Silicones. Mixes of various proportions were prepared from both type I portland cement (non-air-entrained) and type IA portland cement (air-entrained). Some mixes tested included natural cement blended with the portland cement. ***Harold L. Cahn and Royal V. Mackey, Jr.*** *ASTM Bulletin*, no. 235, Jan. 1959, p. 37-42.

6199 Development of a Foamed Alumina Cement. A lightweight phosphate bonded alumina cement was foamed by means of acid-reaction with aluminum powder in the presence of a foam stabilizer. This high alumina insulating refractory is suggested for use at temperatures up to 3100 F. ***W. F. Zimmerman.*** *American Ceramic Society Bulletin*, v. 38, Mar. 1959, p. 97-98.

6200 Thermal Stresses in Ceramic Cylinders Used in Vacuum Tubes. Describes an investigation into the behavior of ceramic cylinders used in vacuum tubes when subjected to heat which is generated during normal tube operation. A theory of stresses in terms of axial temperature gradients and the mechanical properties of the material and cylinder geometry is developed for the particular case of cylinders with cooled ends and temperature distributions that are symmetrical about the axis. Experimental test results are given for a number of different materials and geometries. The effects of grinding and of firing on thermal stress resistance were studied, and a thermal stress resistance factor is tabulated for various materials. ***Donald H. Preist and Ruth Talcott.*** *American Ceramic Society Bulletin*, v. 38, Mar. 1959, p. 99-105.

6201 Dielectric Losses of Some Simple Ternary Silicate Glasses. Effect on alkali ion mobility of compositional changes in simple glasses was investigated by observing the dielectric loss behavior in a number of ternary glass systems, formed by

adding increasing amounts of various third components to K_2O-SiO_2 and Na_2O-SiO_2 base glasses. Oxides of Ba, Sr, Ca, Cd, Pb, Mg, Zn, Al, B, Sn, Zr, Ti, and Si were introduced. Curves for SnO_2, Al_2O_3, and ZrO_2 additions passed through a minimum and in the latter two cases rose to tan δ values greater than that of the base glass itself. Curves for the series containing B_2O_3 and TiO_2 continued to lower values throughout the range of compositions studied. ***D. W. Rinehart and J. J. Bonino.*** *American Ceramic Society, Journal,* v. 42, Mar. 1959, p. 107-112.

6202 Exploration of Lithia Glassforming Systems: I. Li_2O-CaO-Al_2O_3-SiO_2 at Different Levels from 0 to 30 Weight % CaO. Thermal, chemical, optical, and electrical properties were determined. Some of the glasses, especially those at the higher CaO levels, may find commercial application. ***H. W. Rauch, C. H. Commons, Jr., and H. H. Blau.*** *American Ceramic Society, Journal,* v. 42, Mar. 1959, p. 113-120.

6203 Studies on $4CaO \cdot Al_2O_3 \cdot 13H_2O$ and the Related Natural Mineral Hydrocalumite. Single-crystal X-ray and electron-diffraction studies show the existence in one polymorph of $4CaO \cdot Al_2O_3 \cdot 13H_2O$ of a hexagonal structural element with $a = 5.74$ a.u., $c = 7.92$ a.u. and atomic contents $Ca_2Al(OH)_7 \cdot 3H_2O$. These structural elements are stacked in a complex way and there are probably two or more polytypes as in SiC or ZnS. On dehydration, $4CaO \cdot Al_2O_3 \cdot 13H_2O$ first loses molecular water and undergoes stacking changes and shrinkage along c. At 150 to 250 C, $Ca(OH)_2$ and $4CaO \cdot 3Al_2O_3 \cdot 3H_2O$ are formed and, by 1000 C, CaO and $12CaO \cdot TAl_2O_3$. The dehydration of hydrocalumite follows a similar course. ***F. G. Buttler, L. S. Dent Glasser, and H. F. W. Taylor.*** *American Ceramic Society, Journal,* v. 42, Mar. 1959, p. 121-126.

6204 Thermal Chemistry of Colloidal Titanium Dioxide. Chemical and physical analyses showed that hydrous titanium dioxide, prepared from titanium sulfate solution, consists of flocculates of small anatase crystals. The kinetics of the transformation were found to be first order, following an induction time which appeared to depend on a nucleation process. Precision X-ray diffraction studies showed that the anatase lattice expanded slightly before the transformation and that the initial rutile formed was expanded. ***William F. Sullivan and Sandford S. Cole.*** *American Ceramic Society, Journal,* v. 42, Mar. 1959, p. 127-133.

6205 Apparatus for the Oscillating-Heating Method of X-Ray Powder Diffraction. Complete schematic details of the electronic circuitry are included, and mechanical details of the program generator are illustrated photographically. The dehydration of clays and related minerals is discussed to illustrate the use of this versatile apparatus. ***R. A. Rowland, E. J. Weiss, and D. R. Lewis.*** *American Ceramic Society, Journal,* v. 42, Mar. 1959, p. 133-138.

6206 Ceramic and Dielectric Properties of Lead Metaniobate Electrical Ceramics. The effect of firing temperature and time on the weight loss, fired porosity, and dielectric properties of lead metaniobate was investigated. The effect of replacing up to 0.7 mole fraction of the lead ion in lead metaniobate by cadmium was investigated. Cadmium additions lowered the Curie temperature and diluted the ferroelectric properties of lead metaniobate. ***Karl E. Nelson and Ralph L. Cook.*** *American Ceramic Society, Journal,* v. 42, Mar. 1959, p. 138-142.

6207 On the Formation of Fe^{2+} in the System MgO-Fe_2O_3-$MgFe_2O_4$ at High Temperatures. The partial reduction of ferric iron in the system at relatively low temperatures is discussed in terms of the preferential diffusion of iron, and its partial stabilization as ferrous iron from lattice energy considerations. ***L. C. F. Blackman.*** *American Ceramic Society, Journal,* v. 42, Mar. 1959, p. 143-145.

6208 Ceramic Properties of Europium Oxide. Europium oxide compacts fired in O for two hours at 1500 C attained a density of 90% of theoretical and were stable in boiling water; compacts fired under mildly reducing conditions at 1500 C for two hours attained a density of 84% of theoretical and disintegrated in boiling water; those fired similarly in a H atmosphere began to fuse at 1500 C. Investigation of the structural changes occurring in europium oxide with rising temperature revealed that the low-temperature (body-centered cubic) form inverts slowly to the high-temperature form at approximately 1050 C; the high-temperature form has monoclinic symmetry, and it does not revert readily to the cubic form. ***C. E. Curtis and A. G. Tharp.*** *American Ceramic Society, Journal,* v. 42, Mar. 1959, p. 151-156.

6209* Tremie Concrete Controlled With Admixtures. Construction procedure; advantages and disadvantages of tremie concrete; laboratory test program and evaluation of laboratory tests; field experience with admixtures. ***J. Wayman Williams, Jr.*** *American Concrete Institute, Journal,* v. 30; *ACI Proceedings,* v. 55, no. 8, Feb. 1959, p. 839-850.

6210* Expansion and Cracking. Investigation to study the influence of magnesia and alkali contents of cements on the expansion and cracking of concretes made with two aggregates which have poor service records in some structures, and of concrete made with one aggregate which has a good service record. ***W. C. Hansen.*** *American Concrete Institute, Journal,* v. 30; *ACI Proceedings,* v. 55, no. 8, Feb. 1959, p. 867-878.

6211* Wear-Resistant Concrete Construction. Presents requirements for materials, methods, and workmanship in constructing or resurfacing floors, platforms, and aprons subject to heavy traffic or to severe use from the handling of heavy materials. Various methods of treating wearing surfaces. ***Shu-T'ien Li.*** *American Concrete Institute, Journal,* v. 30; *ACI Proceedings,* v. 55, no. 8, Feb. 1959, p. 879-892.

6212* Specific Surface of Aggregates Applied to Mix Proportioning. Suggested proportioning method, applicable to both continuous and gap-graded aggregates, uses specific surface of aggregate as an index of grading. Two charts are offered for use with this method. Fine and coarse aggregate are combined to give the required specific surface. ***B. G. Singh.*** *American Concrete Institute, Journal,* v. 30; *ACI Proceedings,* v. 55, no. 8, Feb. 1959, p. 893-901.

6213* Role of Cement in the Creep of Mortar. Creep of mortar specimens made with 15 different portland cements and subjected to a sustained compressive stress was measured over a period of several months. These tests indicate that creep is approximately proportional to the ratio of applied stress to strength of mortar at the time of load application, regardless of the identity of the cement. ***A. M. Neville.*** *American Concrete Institute, Journal,* v. 30; *ACI Proceedings,* v. 55, no. 9, Mar. 1959, p. 963-984.

6214 Interstitial Patterns. An interstitial pattern is a new type of image that is formed inside glass; it is thus protected by the glass and is permanent. Two processes have been developed for making these new patterns and they achieve the same result by somewhat different means. Basically, colorless ions of silver or copper are forced into the structure of the glass where they are subsequently reduced to the metallic state to form a visible pattern. ***A. J. C. Hall and J. G. Hayes.*** *Australia, Defense Standards Laboratories, Technical Note* 50, Sept. 1958, 14 pp. (T1 Au78.2tn Vis.)

6215* Statistical Estimation of Automatic Control of Milling in a Ball Mill. Accidental fineness errors are proved to follow the normal distribution curve in automatic control of milling and a high-peaked curve in hand control of milling. (*In Russian.*) Statisticheskaia otsenka tochnosti avtomaticheskogo regulirovaniia protsessa pomola v sharovoĭ mel'nitse. ***V. Sh. Bereza.*** *Avtomatika i Telemekhanika,* v. 20, no. 2, Feb. 1959, p. 150-160.

6216* Preparation and Properties of Dense Beryllium Oxide. Demonstrates that high-purity BeO shapes of nearly theoretical density can be made without resorting to severe ceramic-processing measures. Proper calcination of a suitable starting compound appears to be the major factor in obtaining readily sinterable BeO powder. Dense BeO ceramics made from active powder had high strengths when sintered at temperatures low enough to prevent excessive crystal growth. Bend strengths decreased with increasing sintering temperatures in a manner indicating that fracture strength was inversely proportional to the average crystal diameter. ***Collin Hyde, J. F. Quirk, and W. H. Duckworth.*** *Ceramics,* v. 10, Feb. 1959, p. 10 + 5 pages.

6217 Alumina Ceramics. Strength, impact resistance, and hardness compared with other ceramics. *Design News*, v. 14, Mar. 16, 1959, p. 24-25.

6218 Industrial Carbon and Graphite. Manufacture; crystal structure; surface chemical properties and reactivity; electrical behavior; mechanical, nuclear, chemical, and metallurgical applications. 630 pp. 1958. Society of Chemical Industry, London. (TP245.C4 So13i)

6219 The Investigation of Morphology, Origin, and Structure of Fine-Grained Minerals. Selected electron micrographs of clays and other fine-grained minerals. ***Thomas F. Bates.*** 61 pp. College of Mineral Industries, The Pennsylvania State University, University Park, Pa. (TN941 B31s Over.)

6220 Densification During Sintering in the Presence of a Liquid Phase. I. Theory. II. Experimental. Experimental measurements of the densification rate and microstructure changes taking place during sintering of the iron-copper system, which is typical of those systems showing spheroidal grain development, indicate that in this system the rate of densification during liquid phase sintering is controlled by diffusion through a liquid film between particles. I. ***W. D. Kingery.*** II. ***W. D. Kingery and M. D. Narasimhan.*** *Journal of Applied Physics*, v. 30, Mar. 1959, p. 301-310.

6221 Missile Needs Pose Challenges for Ceramics. Predicts demand within decade for materials that will take temperatures up to 4000 F in missiles. Reviews properties, applications, and fabrication techniques for ceramic materials. Surveys requirements for ceramic-to-ceramic and ceramic-to-metal attachments. ***R. T. Inglis and D. L. Krout, Jr.*** *Missiles and Rockets*, v. 5, no. 10, Mar. 9, 1959, p. 34-37.

6222* The Float Process. The introduction of float glass, which is already being used commercially, marks the solving of many new problems concerning the chemical and physical equilibrium between hot liquid glass, hot liquid metal and hot atmosphere, and also the successful development of a full-scale continuous manufacturing method. *Overseas Engineer*, v. 32, Mar. 1959, p. 250.

6223* Studies on (Ba-Pb)(Ti-Zr)O_3 System. Structural studies were performed, and the phase diagram of the system was determined. ***Takuro Ikeda.*** *Physical Society of Japan, Journal*, v. 14, Feb. 1959, p. 168-174.

6224 Some Physical Properties of Concrete at High Temperatures. Experimental techniques are described and data are presented on the thermal expansion, density, and dynamic modulus of elasticity of concrete in the range 75-1500 F. ***Robert Philleo.*** *Portland Cement Association, Research Department Bulletin* 97, Oct. 1958, p. 857-864. (TP883 P83b Vis.)

6225 The Setting of Portland Cement. A Review of Theory, Performance and Control. Introductory history; setting of ground clinker, and gypsum-retarded cement; chemical action of gypsum; other retarders of clinker; effects of calcium sulfate in other forms; liquid phase in cement paste; altering the setting time of normally retarded cement; troubles with gypsum-retarded cement; remedial measures; testing for early stiffening and early reactions in cement paste. ***Harold H. Steinour.*** *Portland Cement Association, Research Department Bulletin* 98, Nov. 1958, 124 pp. (TP883 P83b Vis.)

6226* The Liquid Phase in Firebricks. Separation from mullite crystals; differences in color; chemical nature; particle size; optimum condition for separation; quantitative estimation of mullite and liquid phase. ***Arun Kumar Bose and Hans-Ernst Schwiete.*** *Refractories Journal*, v. 35, Feb. 1959, p. 58-67.

6227* Refractories and Oil Firing. Royal Dutch Shell specification for refractory bricks and shapes. Pyrometric properties and chemical composition; scope for corundum. ***D. Dixon.*** *Refractories Journal*, v. 35, Feb. 1959, p. 70-76.

6228* Effect of the Degree of Sintering on the Properties of Mixed Nickel Ferrites. Two double nickel ferrites of different compositions, one, of formula 15 NiO.35 ZnO.50 Fe_2O_3 marked by R_4, the others of formula 25 NiO.40 ZnO.35 Fe_2O_3 marked by R_8 and a mixed copper-nickel-ferrite of formula 16 CuO.4 NiO.30 ZnO.50 Fe_2O_3 marked by RC_4. The change of the properties of the ferrites R_4 and R_8 were studied as function of the sintering temperature. Temperature increase has a positive effect on sintering and on the magnetic permeability of the material. Exceeding the sintering temperature increases the porosity and impoverishes the magnetic properties. (*In German.*) Einfluss des Sintergrades auf die Eigenschaften gemischter Nickelferrite. ***Elena Lăbuscă, Gh. Stancu, and N. Andreescu.*** *Revue de Métallurgie (Bucharest)*, v. 3, no. 3, 1958, p. 79-86.

6229* Scientific and Technical Data on the Burning of Limestone. Burning in a vertical kiln. Exploitation of a modern kiln. (*In French.*) Données scientifiques et techniques relatives à la cuisson du calcaire. ***J. Wuhrer.*** *Revue des Matériaux de Construction (Edition C)*, 1959, no. 520, Jan., p. 16-22.

6230 Recrystallization of Corundum. Describes manufacture, structure, and properties of Russian cutting tool "TsM-332" (also called "Corundum-Microlite). Alumina + 0.5-1.0% MgO is ground to 0.5-0.75μ, pressed, and heated 5-10 min. at 1750 C. Resulting body has grains only 1-3μ with flexural strength up to 50-55 kg/mm^2. (*In Russian.*) O rekristallizatsii korunda. ***N. M. Pavlushkin.*** Paper from "Rezaniye Mineralokeramicheskimi Instrumentami". p. 37-48, 1958. Publishing House of the Defense Industry, Moscow. (TJ1186 N22r)

6231* Structure of the $TiO_2.Al_2O_3$ Compound. Comparison With Pseudo Brookite. The structure, established in an approximative way by Austin, was more precisely determined. The coordinates are close to those mentioned by Austin; there is a slight difference in the position of the atoms of aluminum and of one of the O_3 oxygens. The isomorphism of this compound and pseudo-brookite is proved by the two *X* and Z projections. (*In French.*) Structure du composé $TiO_2.Al_2O_3$. Comparaison avec la pseudo-brookite. ***Michelle Hamelin.*** *Société Chimique de France, Bulletin*, 1958, nos. 11-12, Nov.-Dec., p. 1559-1566.

6232* Influene of Fineness of Grinding of Corundum on Its Sintering. Influence of grinding and calcining treatments on grain size and fired properties. (*In Russian.*) Vliianie dispersnosti na spekanie korunda. ***N. M. Pavlushkin.*** *Steklo i Keramica*, v. 16, no. 1, Jan. 1959, p. 11-15.

6233 Metal Fiber Reinforced Ceramics. Techniques were developed for the sintering and hot pressing of alumina and alumina containing 5 wt. %, 10 wt. %, and 20 wt. % molybdenum fibers. The physical and mechanical properties of alumina containing these percentages of ½ in. long by 0.002 in. dia. fibers were determined and compared to those of the alumina. The alumina was superior in strength and impact resistance but there was some indication that the aluminas containing 10 and 20 wt. % additions of fiber were superior in thermal shock resistance. All alumina samples containing 10 and 20% additions developed microcracks while only some 5% samples developed these cracks. ***R. S. Truesdale, J. J. Swica, and J. R. Tinklepaugh.*** *U. S. Air Force, Wright Air Development Center, WADC Technical Report* 58-452, Dec. 1958, 36 pp. (TL507 Un3.18w Vis.)

6234 Preparation and Properties of Uranium Monocarbide Castings. Using a special arc-melting technique, sound, homogeneous 100-g cylindrical castings of UC of near stoichiometric composition were consistently produced. In the casting process developed, UC buttons previously prepared by arc melting the elements were placed over the opening of a graphite mold in a helium-atmosphere arc furnace. When the UC button became fully molten under the arc, it dropped by gravity into the mold. The densities of the resultant castings were about 98% of theoretical. The castings could be successfully machine ground using a water-base cutting fluid. Cast UC encapsuled in stainless steel exhibited good resistance to thermal stress and shock in two series of tests of 100 thermal cycles to 900 C and 100 cycles to 1100 C. In tests of compressive strength on a single specimen rupture occurred at 54,500 psi. ***Arthur C. Secrest, Ellis L. Foster, and Ronald F. Dickerson.*** *U. S. Atomic Energy Commission, BMI*-1309, Jan. 2, 1959, 16 pp. (UF767 U3b Contin.)

6235 Diffusion of Beryllium in Beryllium Oxide. ***Stanley B. Austerman.*** *U. S. Atomic Energy Commission, NAA-SR*-3170, Dec. 15, 1958. 22 pp. (UF767 Un3.1na Contin.)

6236 Stability of Ceramics in Hydrogen Between 4000° and 4500°F. Materials were heated inductively in a tungsten cup between 4000 and 4500 F for two 1-hour periods under a static hydrogen atmosphere. Weight, pressure, and diffraction pattern changes were observed, and these served to indicate the extent of reaction. Most of the ceramics, HfC, ZrC, TiC, TaC, NbC, WC, Mo_2C, HfN, ZrN, NbN, ZrB_2, NbB_2, and WB, showed less reaction than the minimum detectable value. However, TiN, TaN, HfB_2, TiB_2, ZrO_2, and Cr_2O_3, apparently reacted to a measurable extent with hydrogen. Reactions of SiC, VC, and TaB_2 were not determinable because of their incompatibility with the tungsten container. ***Charles E. May, Donald Koneval, and George C. Fryburg.*** *U. S. National Aeronautics and Space Administration, NASA Memorandum* 3-5-59E, Mar. 1959, 13 pp. (TL782 Un3rm Vis.)

See also: **6317** (K_2O in glass); **6318** (glass analysis); **6464** (spectrophotometric evaluation of colorants); **6717** (blast resistance of reinforced concrete); **6726** (design of reinforced concrete structures); **6874** (use of ceramic cutting tools); **6875** (ceramic cutting tools); **6909** (oxide magnets).

CHEMICAL ENGINEERING

6237* Safe Use and Safe Handling of Organic Isocyanates. Toxicity, plant and laboratory design, decontamination facilities, protective equipment, safety procedures and emergency measures for isocyanate exposures. ***S. C. Strayer.*** *A.M.A. Archives of Industrial Health*, v. 19, no. 3, Mar. 1959, p. 91-93.

6238* International Aerosol Laboratory Established in Switzerland. The primary function of the Chemtech AG, a subsidiary of Precision Valve International, Zurich, will be to narrow the gap in technological knowledge between Europe and the U. S. in quality control systems, laboratory procedures, and pure research. *Aerosol Age*, v. 4, Mar. 1959, p. 28 + 1 page.

6239* Centrifugal Pump Troubles. Problems on the installation, operation, and maintenance of centrifugal pumps which might arise from mechanical causes. ***Igor J. Karassik and Roy Carter.*** *Air Conditioning, Heating, and Ventilating*, v. 56, Mar. 1959, p. 83-84.

6240* Hi-Btu Gases From Fluid Fuels. Present and Future Methods. II. Production From Natural Gas Liquids and Petroleum Oils. ***Henry R. Linden and Martin A. Elliott.*** *American Gas Journal*, v. 186, Feb. 1959, p. 22-27.

6241* Continuous Acidulation Process for Tall Oil Production. The conventional batch process was changed to a semicontinuous one by properly sizing tanks to reaction times and adding a screen and a continuous centrifugation step. An entirely new, continuous acidulation process has been developed which includes proportioning of reagents, controlled mixing, and degasification, followed by tall oil separation in a special form of nozzle type of centrifuge. These processes produce higher quality tall oil at lower cost than the original batch process. ***Frank E. Sullivan.*** *American Oil Chemists' Society, Journal*, v. 36, Mar. 1959, p. 124-127.

6242* Plastics in the Chemical Industries. A tabular presentation of reference data. *Applied Plastics*, v. 1, May 1958, p. 30-31.

6243 A More Productive Coke Oven—Speculative Thoughts on Its Future Size. ***Joseph S. Mohr, Jr.*** *Blast Furnace and Steel Plant*, v. 47, Mar. 1959, p. 277-280.

6244* Heat-Transfer Charts for Time-Variable Boundary Conditions—Semi-Infinite Solid. Charts are presented for the solution of the general problems of determining temperature in a semi-infinite solid when the boundary temperature (or flux per unit area per unit time) is an arbitrarily plotted function of time, and determining an unknown boundary temperature (or flux per unit area per unit time) from a given temperature recording of a point in the solid. ***Taghi J. Mirsepassi.*** *British Chemical Engineering*, v. 4, Mar. 1959, p. 130-136.

6245* Simultaneous Heat and Mass Transfer in Cooling Towers. I. Experimental work shows that the liquid-film resistance to heat transfer is not negligible. ***W. J. Thomas and P. Houston.*** *British Chemical Engineering*, v. 4, Mar. 1959, p. 160-163.

6246* Horizontal Movement of Water in Soil. Description of a laboratory experiment to determine the rate of extraction and the distance water will move in a horizontal radial system. The rate of extraction varied directly with the soil moisture tension. In a horizontal radial system water will move at least 45 cm. in soils at moisture tensions up to 100 cm. of water, and at least 14 cm. in soils with moisture tensions up to 462 cm. of water. ***D. W. L. Read.*** *Canadian Journal of Soil Science*, v. 39, no. 1, Feb. 1959, p. 27-31.

6247 Redesign Improves Use of Reaction Heat. Production of steam at a Tacoma, Wash., HCHO unit. *Chemical Engineering*, v. 66, Mar. 9, 1959, p. 77-78.

6248 Electric Furnaces. Potential as a tool for chemical processing. Arc, resistance, and induction furnaces. ***E. D. Porter.*** *Chemical Engineering*, v. 66, Mar. 9, 1959, p. 133-136.

6249 Condensing and Boiling Coefficients. Graphs for evaluating coefficients of heat transfer. ***Ning Hsing Chen.*** *Chemical Engineering*, v. 66, Mar. 9, 1959, p. 141-146.

6250 How to Estimate Mixture Viscosities. ***Wallace R. Gambill.*** *Chemical Engineering*, v. 66, Mar. 9, 1959, p. 151-152.

6251 Low-Pressure Vessel Stores Liquefied Gases. Refrigerated low-pressure storage as a means of saving on equipment costs. ***C. C. Van Soye.*** *Chemical Engineering*, v. 66, Mar. 23, 1959, p. 112.

6252 Conversion of Uranium Trioxide to Uranium Hexafluoride in Three-Step Process. Process flowsheet. The process handles variable-quality UO_3 feed, controls high reaction heats, holds to close, high temperature limits, involves handling moist HF gas at 1000 F. ***C. S. Cronan.*** *Chemical Engineering*, v. 66, Mar. 23, 1959, p. 140-143.

6253 Put the Viscous Fluid in the Shell. Advantages of shellside heat transfer. ***C. J. Dobratz.*** *Chemical Engineering*, v. 66, Mar. 23, 1959, p. 179-180.

6254* Some Remarks on Chemical Equilibrium and Kinetics in the Nitrogen Oxides-Water System. Consideration of a substantial body of kinetic evidence which specifies N_2O_4 as the chief reactant species in the NO_2-N_2O_4-H_2O-HNO_3 system suggested that the equilibrium data for this system would be more logically expressed in terms of N_2O_4. Apparent temperature independence is achieved by this manner of correlation. Literature data proving the ionization of N_2O_4 in solutions are in accord with the kinetic and equilibrium data. ***J. J. Carberry.*** *Chemical Engineering Science*, v. 9, no. 4, Feb. 1959, p. 189-194.

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6256 Chemical Processing of Nuclear Fuels. Presents the problems of chemical processing of the fuel after it has been irradiated in a reactor, primarily for those who are interested in the role of nuclear fuel processing in nuclear power systems. Many of the aqueous processes which are described are applicable to the purification of uranium and thorium concentrates. ***F. S. Martin and G. L. Miles.*** 242 pp. 1958. Academic Press, New York. (TK9360 M36c)

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du Bassin de Lorraine". (*In French.*) Les nouveaux procédés de carbonisation des charbons jeunes. Les conséquences de leur développement industriel dans le domaine du traitement des goudrons primaires et de la carbochimie. ***J. Moussu, C. Barre, and R. Chaux.*** *Chimie & Industrie*, v. 81, no. 2, Feb. 1959, p. 195-203.

6258 Cyclohexylamine for Corrosion Prevention in Steam-Raising Equipment. Description of the properties and use of cyclohexylamine, a material which has found widespread application for the treatment of boiler water to prevent corrosion of metal surfaces by dissolved CO_2. ***W. K. Ashcroft and P. N. Heron.*** *Corrosion Technology*, v. 6, Mar. 1959, p. 85-88.

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6261* The Use of Steel Grids in Tower Purifiers. An account of experiences in the use of steel purifier grids. *Coke and Gas*, v. 21, Mar. 1959, p. 118-120.

6262* Water Distillation Using Waste Heat. Flow diagram of a 100 tons per day sea water distilling plant. *Engineer*, v. 207, Mar. 13, 1959, p. 428.

6263* How Special Receiving Facilities Handle Liquefied Natural Gas at Canvey Island. These facilities, including heavily insulated tanks and lines, with provision for carry-off of constant vaporization, mark unloading and dockside handling facilities in preparation for transmission to reforming plant. *Gas Age*, v. 123, Mar. 19, 1959, p. 33-34.

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6268* Mechanical Entrainment of Liquid by Gas in Plate Columns. Investigates causes for a considerable increase in the efficiency of plate columns by replacing cap plates by net, grill, or Uniflex plates. (*In Russian.*) Mekhanicheskiĭ unos zhidkosti gazom v tarel'chatykh kolonnakh. ***Iu. K. Molokanov and A. I. Skoblo.*** *Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Fizika*, 1959, no. 1, p. 49-55.

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6271* Controlling Slurried Reagent Feed Rate. A time-modulated reagent control system for slurry feeding with a Delta valve overcomes problems due to sand and abrasive material in milk of lime. ***Carl Marquardt.*** *Mining World*, v. 21, no. 3, Mar. 1959, p. 52-53.

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6275 Two Significant Advances Mark Operation of United Gas Pipe Line. The first centrifugal compressor unit driven by a gas turbine to be used in the origin of the line. Ebullient cooling makes power available for other uses. ***H. W. Egger.*** *Oil and Gas Journal*, v. 57, no. 14, Mar. 30, 1959, p. 184-186.

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6279* The Role of Science in the Development of the Chemical Industry. Reviews progress in the development of the chemical industry in the USSR and future plans with an emphasis on synthetic materials. (*In Russian.*) Razvitie khimicheskoĭ promyshlennosti i nauka. ***K. F. Vinogradov.*** *Priroda*, v. 48, no. 2, Feb. 1959, p. 31-38.

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6287 Design and Operating Criteria for Fluorine Disposal by Reaction With Charcoal. Experiments have shown that this method is effective over a wide range of conditions. Design parameters may be based on the stoichiometric requirements plus sufficient excess charcoal to maintain desired efficiency toward the end of a disposal operation. ***Harold W. Schmidt.*** *U. S. National Aeronautics and Space Administration, NASA Memorandum* 1-27-59E. Feb. 1959, 18 pp. (TL782 Un3rm Vis.)

6288* Water System Operation. In connection with a water distribution analysis for Wichita, Kansas, a study of the recording charts indicated pronounced variations in pressure and pumpage during the evening TV programs. ***R. L. Brown.*** *Water & Sewage Works*, v. 106, Feb. 1959, p. 78.

6289* Saline Water Conversion. Solar stills, evaporators, electrodialysis, and freezing show promise of providing relatively low-cost techniques. ***Sheppard T. Powell.*** *Water & Sewage Works*, v. 106, Feb. 1959, p. 84-86.

6290* Petrochemical Horizons for Propylene. V. Propylene-Derived Detergents—Polypropylene. ***Peter W. Sherwood.*** *World Petroleum*, v. 30, Mar. 1959, p. 98 + 4 pages.

See also: **6329** (zone refining); **6593** (gas-vapor cooler condenser design); **6601** (power in non-Newtonian agitation); **6632** (shale oil development); **6643** (yield-depression curves of discharging wells); **6976** (disposal of spent-fuel shield water); **7131** (plastics in chemical industries).

CHEMISTRY—ANALYTICAL

6291* About the Determination of Al_2O_3 in Aluminum and Its Alloys. The bromine-methanol and gaseous HCl methods for determination of Al_2O_3 in Al and its alloys. Changes applied to the original method of Urech and collaborators for improvement of testing conditions. Some observations on the photometric determination of Al by eriochromocyanine. (*In Italian.*) Sulla determinazione dell' ossido di alluminio nell' alluminio e sue leghe. ***G. Matelli and E. Attini.*** *Alluminio*, v. 28, no. 2, Feb. 1959, p. 61-63.

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6300* Separation and Identification of Carcinogenic Polynuclear Aromatic and Related Compounds by Paper Chromatography: 9-Anthraldehyde, 1,9-Benzanthrone, 3-4-Benzpyrene, Chrysene, 1,2,5,6-Dibenzanthracene, 3-Methylcholanthrene, Phenanthrenequinone, and Pyrene. ***Lloyd C. Mitchell and Daniel Banes.*** *Association of Official Agricultural Chemists, Journal*, v. 42, no. 1, Feb. 1959, p. 161-168.

6301 The Determination of Dialkyltin Compounds in Polyvinylchloride. ***A. H. Chapman, M. W. Duckworth, and J. W. Price.*** *British Plastics*, v. 32, Feb. 1959, p. 78 + 1 page.

6302 The "Thorin" Colorimetric Method for Thorium Determination: Effect of Some Common Ions, and Methods for Overcoming Interferences. Comparison of two reducing agents, ascorbic acid and hydroxylamine hydrochloride, for overcoming the interference of Fe and Ce. ***J. A. F. Bouvier and R. J. Guest.*** *Canada, Mines Branch, Research Report*, R-34, Nov. 26, 1958, 14 pp. (TN26 C16.Sr Contin.)

6303* Determination of Small Amounts of Beta-Naphthylamine in Alpha-Naphthylamine. Method is based on the colorimetric reaction of furfural with primary aromatic amines. Method can be also applied to the determination of nitronaphthalene, after reduction of nitro derivative. (*In Italian.*) Determiniazione di piccole quantità di betanaftilammina nell' alfanaftilammina. ***Giovanni Parravano.*** *Chimica e l'Industria*, v. 41, Jan. 1959, p. 30-33.

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See also: **6438** (soybean vinyl ether copolymers); **6701** (infrared spectrophotometry); **6703** (automatic titrimetry); **6845** (determination of H in steel).

CHEMISTRY—INORGANIC AND GENERAL

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6371* Reaction of Iminohydrosulfates With Conjugated Dienes. With a view to extending the study of the philodiene property of the iminochlorides to other iminosalts, iminohydrosulfates produced in the presence of diene were tested by means of the effect of concentratd sulfuric acid on nitrile. With the ethylene aromatic isosafrole and methylisoeugenol dienes, these iminohydrosulfates led to the same derivatives of dihydro-3,4 isoquinoline obtained when iminochlorides were used. (*In French.*) La réaction des iminohydrosulfates avec des dièenes conjugués. ***Manuel Lora-Tamayo, Guillermo García Muñoz, and Ramón Madroñero.*** *Société Chimique de France, Bulletin*, 1958, nos. 11-12, Nov.-Dec., p. 1334-1337.

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6375* Raney Nickel Reductions. VIII. A Synthesis of 1:2-Benzanthracene and Its 3'-Methyl and 4-Methyl Derivatives. ***N. B. Desai and K. Venkataraman.*** *Tetrahedron*, v. 5, no. 4, Feb. 1959, p. 305-310.

6376* The Basic Chemistry of Dyes and Dyeing. I. What color is; what makes dyes soluble; raw materials: hydrocarbons, nitrogen compounds, oxygen compounds; intermediates and their uses. ***William Postman.*** *Textile World*, v. 109, no. 3, Mar. 1959, p. 95 + 3 pages.

6377* On the Reaction Between Aluminium Triethyl or Triphenyl and Chromium Acetylacetonate. The stoichiometry of the reactions between $Al(C_2H_5)_3$ or $Al(C_6H_5)_3$ and $Cr(acac)_3$ is examined by quantitative determination of gaseous reaction products or unreacted reagents as well as by conductometric titration. The reaction products are considered as formed essentially by coordination of the organoaluminum compound to the oxygen atoms of the acetylacetonate. ***Guido Sartori and Giacomo Costa.*** *Zeitschrift für Elektrochemie; Berichte der Bunsengesellschaft für Physikalische Chemie*, v. 63, no. 1, 1959, p. 105-111.

CHEMISTRY—PHYSICAL

6378 Advances in Chemical Physics. Statistical-mechanical theory of transport processes. Theoretical and experimental aspects of isotope effects in chemical kinetics. Dielectric properties of dilute polymer solutions. Some physical aspects of gaseous chemical kinetics. Transport processes in liquids. Relation between structure and chemical reactivity of aromatic hydrocarbons. Molecular theory of surface tension. Molecular orbital theory. Intermolecular forces and equation of state of gases. Statistical mechanics and electromagnetic properties of matter. Application of the theory of stochastic processes to chemical kinetics. ***I. Prigogine, editor.*** v. I, 414 pp. 1958. Interscience Publishers, New York. (QD453 Ad95 Vis.)

6379* Study of Systems Containing Concentrated Hydrogen Peroxide. XVII. Isotherms of Solubility and Solid Phases of $Ba(OH)_2$—H_2O_2—H_2O Ternary Systems. Investigating the reaction of aqueous solutions of $Ba(OH)_2$ with H_2O_2 in wide intervals of concentration of H_2O_2 revealed the presence and active composition of equiponderant solid peroxide phases of the system $BaO_2 \cdot 8H_2O$, $BaO_2 \cdot H_2O_2$, and $BaO_2 \cdot 2H_2O_2$. (*In Russian.*) Izuchenie sistem s kontsentrirovannoĭ perekis'iu vodoroda. XVII. Izotermy rastvorimosti i tverdye fazy troĭnoĭ sistemy $Ba(OH)_2$–H_2O_2–H_2O. ***S. Z. Makarov and N. K. Grigor'eva.*** *Akademiia Nauk SSSR, Izvestiia, Otdelenie Khimicheskikh Nauk*, 1959, no. 1, Jan., p. 9-16.

6380 A Study of the Methyl-Oxygen and the Methyl-Nitric Oxide Reactions by Flash Photolysis. Flash photolysis of azomethane was studied in experiments with added inert gases and oxygen or nitric oxide. ***William C. Sleppy and Jack G. Calvert.*** *American Chemical Society, Journal*, v. 81, Feb. 20, 1959, p. 769-774.

6381 Low-Temperature Heat Capacities and Entropies at 298.15°K of Crystalline Lead Metasilicate, Lead Orthosilicate and Cadmium Metasilicate. Heat capacities were measured between 51 and 298 K. The entropies at 298.15 K are 26.2 ± 0.3, 44.6 ± 0.5, and 23.3 ± 0.2 cal/deg. mole, respectively. ***E. G. King.*** *American Chemical Society, Journal*, v. 81, Feb. 20, 1959, p. 799-803.

6382 The Density of Solid Ozone. Density was determined at 77.4 K and found to = 1.728(± 0.002) g/cm³. ***A. G. Streng and A. V. Grosse.*** *American Chemical Society, Journal*, v. 81, Feb. 20, 1959, p. 805-806.

6383 Identification of an Intermediate Compound in the Partial Oxidation of Pentaborane-9. Possible structural configurations of the compounds with the formula $B_2H_2O_3$. ***J. F. Ditter and I. Shapiro.*** *American Chemical Society, Journal*, v. 81, Mar. 5, 1959, p. 1022-1026.

6384 The Molecular Structure of Perfluorocarbon Polymers. Infrared Studies on Polytetrafluoroethylene. Infrared absorption spectrum in the 5000-270 $cm.^{-1}$ region. ***R. E. Moynihan.*** *American Chemical Society, Journal*, v. 81, Mar. 5, 1959, p. 1045-1050.

6385 The Influence of Solvent on the Rate of Aromatic Chlorination. ***L. J. Andrews and R. M. Keefer.*** *American Chemical Society, Journal*, v. 81, Mar. 5, 1959, p. 1063-1067.

6386 Formation of Hydrogen Peroxide by Ultrasonic Waves: Free Radicals. ***Alfred Weissler.*** *American Chemical Society, Journal*, v. 81, Mar. 5, 1959, p. 1077-1081.

6387 The Solubility of Carbon Dioxide in Water at High Temperatures. Values are reported for the solubility of CO_2 in water up to 350 C. The anomalous behavior of water compared with other liquids as a solvent for gases is reviewed. ***A. J. Ellis.*** *American Journal of Science*, v. 257, no. 3, Mar. 1959, p. 217-234.

6388* Reactions of Oxygen Activated by Electrical Discharge With Butene-1. Reactions were studied in a "spherical diffusion" reaction zone. ***J. M. S. Jarvie and R. J. Cvetanović.*** *Canadian Journal of Chemistry*, v. 37, Mar. 1959, p. 529-540.

6389* The Metal-Catalyzed Decomposition of Nitrous Oxide(I). Decomposition on Pure Silver, Silver-Gold, and Silver-Calcium Alloys. ***Kenneth E. Hayes.*** *Canadian Journal of Chemistry*, v. 37, Mar. 1959, p. 583-589.

6390 Chemical Constitution. An Introduction to the Theory of the Chemical Bond. Topics include polysulfides, color of inorganic substances, virial theorem, quadrupole coupling constant, stereochemistry of simple compounds, crystal field theory, and cyclopentadienyl-metal complexes(ferrocene). ***J. A. A. Ketelaar.*** 2nd Rev. Ed. 448 pp. 1958. Elsevier Publishing Co., New York. (QD501 K49c2)

6391* The Dissociation Constants of Carboxytropone and Carboxytropolones. Dissociation constants determined by

potentiometric titrations with a glass electrode. ***Nobuyuki Tanaka, I. T. Oiwa, Toshiko Kurosawa, and Tetsuo Nozoe.*** *Chemical Society of Japan, Bulletin*, v. 32, no. 1, Jan. 1959, p. 92-96.

6392* Kinetic Equations of Homogeneous Reactions. The kinetic schemes are classified according to the order of reaction, the number of components and the "fullnesss" of the scheme. At the greater of the schemes the dependence of the concentration of components on time and the method of calculation of velocity constants are discussed. In conclusion, the prospects of this field of chemical kinetics are pointed out. (*In Czech.*) Kinetické rovnice homogenních reakcí. ***Rudolf Zahradnik.*** *Chemické Listy*, v. 53, no. 1, Jan. 1959, p. 56-103.

6393* Chelation Techniques. Discussion of techniques that employ chelation or depend upon chelation for their success. ***Therald Moeller.*** *Chemistry in Canada*, v. 11, Mar. 1959, p. 32-38.

6394* The Low-Temperature Vapour-Phase Oxidation of *cyclo*Hexane. Vapor-phase oxidation at temperatures below 450 C were studied in a flow type apparatus. Products of oxidation were examined by methods which include gas chromatography. ***D. H. Allen, F. H. Garner, R. Long, and J. R. Todd.*** *Combustion and Flame*, v. 3, no. 1, Mar. 1959, p. 75-96.

6395* Determining the Degree of Substitution in Hydroxyethylcelluloses by Means of Phthalic Anhydride. (*In French.*) La détermination du degré de substitution dans les hydroxyéthylcelluloses: dosage par l'anhydride phtalique. ***Jean Quinchon.*** *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*, v. 248, no. 2, Jan. 12, 1959, p. 225-228.

6396* Using Infrared Spectroscopy to Study Some Addition Compounds of Cellulose Nitrate. Two plasticizers, camphor and diphenyldiethylurea, were studied on the basis of the assumed formation of hydrogen bonds between the carbonyl groups of the plasticizer molecules and the non-esterified hydroxyl groups of cellulose nitrate. (*In French.*) Étude par spectroscopie infrarouge de quelques composés d'addition du nitrate de cellulose. ***Marie-Louise Josien, Georges Champetier, and Gilbert Chérubin.*** *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*, v. 248, no. 5, Feb. 2, 1959, p. 685-688.

6397 The System LiF-LiCl, LiF-NaCl, LiF-KCl. Liquid-solid equilibrium data for the systems were obtained through the concentration range 0-100 mole % LiF. ***H. M. Haendler, P. S. Sennett, and C. M. Wheeler, Jr.*** *Electrochemical Society, Journal*, v. 106, Mar. 1959, p. 264-268.

6398 The Surface Change and Sedimentation of Thoria Suspensions. I. The Electrophoretic Behaviour of Thoria Particles in Aqueous Solutions of Acids, Alkalis and Various Salts. II. The Sedimentation of Dilute and Concentrated Suspensions in Relation to Particle Size and the Verwey-Overbeek Theory of Sol Stability. ***H. W. Douglas and J. Burden.*** *Faraday Society, Transactions*, v. 55, Feb. 1959, p. 350-362.

6399* Studies on Sea Water Refrigeration Concentration. I. Freezing Temperature of Sea Brine. II. Change in Composition Through Refrigeration Concentration of Sea Brine. III. Specific Gravity of Sea Brine. IV. Viscosity of Freeze Concentrated Sea Brine. V. Electric Conductivity of Sea Brine. VI. Solubility of Sodium Sulfate in the Freeze Concentrated Sea Brine. VII. Specific Heat of Freeze Concentrated Sea Brine. VIII. Solubility of Light Gas Oil in Sodium Sulfate Solution. IX. Solubility of Water and Sodium Chloride Solution in Benzene. I. ***Shuji Umano and Shigetake Kawasaki.*** II ***Shuji Umano, Yoshinobu Nakano, Shigetake Kawasaki, and Ichiro Hayano.*** III. ***Shuji Umano and Shigetake Kawasaki.*** IV-VI. ***Shuji Umano and Yoshinobu Nakano.*** VII. ***Shuji Umano and Shigetake Kawasaki.*** VIII-IX. ***Shuji Umano and Ichiro Hayano.*** *Government Chemical Industrial Research Institute, Tokyo Reports*, v. 53, Nov. 1958, p. 365-399.

6400 The Determination of Solubility of Difficulty Soluble Compounds With the Aid of Non-isotopic Radioactive Indicators. A method has been worked out for the determination of solubility of difficultly soluble compounds with the aid of radioactive indicators which are nonisotopic but truly isomorphous with the given compounds, and the effect of the degree of achievement of thermodynamic equilibrium between the whole of the solid phase and the saturated solution upon the character of the curves used for calculating the solubilities has been examined. ***N. B. Mikheev.*** *International Journal of Applied Radiation and Isotopes*, v. 5, no. 1, Feb. 1959, p. 32-36.

6401* Effects of Ionizing Radiation on the Aqueous Solutions of Oxalic Acid. II. Oxalic Acid Used as a Chemical Dosimeter for Dosages Between 1.6 and 160 Mrads. III. Radiolysis in the Presence of Oxygen. IV. Effect of pH on the Efficiency of Radiolysis in the Absence of Oxygen. (*In French.*) Action des rayonnements ionisants sur les solutions aqueuses d'acide oxalique. II. Acide oxalique aqueux utilisé comme dosimètre chimique pour les doses entre 1,6 et 160 Mrads. III. Radiolyse en présence d'oxygène. IV. Influence du pH sur le rendement de la radiolyse en l'absence d'oxygène. ***Ivan Draganić.*** *Journal de Chimie Physique*, v. 56, Jan. 1959, p. 9-20.

6402* The Complex Dielectric Constant and the Phase Transitions in the Solid State of Some Cyclohexane Derivatives. Measuring the low frequency complex dielectric constant (80 c/s-40 Mc/s) in cyclohexanol, chlorocyclohexane, cyclohexanone, and thiacyclohexane, and investigating the effect of the electric field on the first and second order transitions. (*In French.*) La constante diélectrique complexe et les transitions de phase a l'état solide de quelques dérivés du cyclohexane. ***Lydia Reinisch.*** *Journal de Chimie Physique*, v. 56, Jan. 1959, p. 108-128.

6403 Solubility of Hydrogen Halides in Organic Compounds Containing Oxygen. II. Assessment of Contributions of Groups in Alcohols. III. Solubility of Hydrogen Chloride in Alcohols and Certain Esters at Low Temperatures. II. ***W. Gerrard and E. D. Macklen.*** III. ***W. Gerrard, A. M. A. Mincer, and P. L. Wyvill.*** *Journal of Applied Chemistry*, v. 9, pt. 2, Feb. 1959, p. 85-93.

6404 The Reversible and Irreversible Thickening of Stirred Partially Fused Mixtures of RDX and TNT. ***W. O. Williamson.*** *Journal of Applied Chemistry*, v. 9, pt. 2, Feb. 1959, p. 120-126.

6405* Phase Relations in the Nitric Acid-Nitrogen Dioxide-Water System at Physicochemical Equilibrium. Measurements of the phase relations were made at temperatures between 85 and 150 C and for the ratios of vapor volume to total volume from 0.8 to near zero, the bubble point of the mixture. ***Webster B. Kay and Manoj D. Sanghvi.*** *Journal of Chemical and Engineering Data*, v. 4, no. 1, Jan. 1959, p. 22-32.

6406 Fundamental Processes of Autoxidation. A review article to summarize the mechanism of this reaction. Deals with liquid phase oxidations occurring at lower temperatures. ***Glen A. Russell.*** *Journal of Chemical Education*, v. 36, Mar. 1959, p. 111-118.

6407 Interaction of Rare Gases With Metal Surfaces. I. A, Kr, and Xe on Tungsten. Interactions were examined in the field emission microscope. Bombardment by rare gas ions results in a penetration of the lattice and an apparent diminution of the work function; bombardment damage is partly annealed between 79 and 300 K. ***Gert Ehrlich and F. G. Hudda.*** *Journal of Chemical Physics*, v. 30, Feb. 1959, p. 493-512.

6408 Microwave Spectrum, Structure, and Dipole Moment of Cyclopropene. Microwave spectra of four isotopic species of cyclopropene were assigned and three rotational constants for each isotopic species were determined. ***Paul H. Kasai, Rollie J. Myers, D. F. Eggers, Jr., and Kenneth B. Wiberg.*** *Journal of Chemical Physics*, v. 30, Feb. 1959, p. 512-516.

6409* Effect of Adsorbed Substances of High Molecular Weight on the Growth of Silver Halide Crystals. ***Ernest J. Perry.*** *Journal of Colloid Science*, v. 14, no. 1, Feb. 1959, p. 27-35.

6410* An Infrared Study of Hydrogen Bonding in Solid H_2O_2 and H_2O-H_2O_2 Mixtures. Infrared absorption, between 2.5 and 25μ, of thin films of pure H_2O_2 was measured at 4 and 80 K. ***P. A. Giguère and K. B. Harvey.*** *Journal of Molecular Spectroscopy*, v. 3, no. 1, Feb. 1959, p. 36-45.

6411* Recent Advances in the Chemistry of Dye-Forming Development. Summary of recent advances; assesses the present state of understanding of the fundamental phenomena involved in the process of color development. ***P. W. Vittum and A. Weissberger.*** *Journal of Photographic Science*, v. 6, no. 6, Nov.-Dec. 1958, p. 157-169.

6412 Acidity Studies of Silica-Alumina Catalysts. Protonic acid content of some acid-type solid catalysts was determined by base exchange with 0.1 *N* ammonium acetate solution followed by *p*H measurement. Procedure also permitted evaluation of the relative acid strengths of the catalysts. ***V. C. F. Holm, G. C. Bailey, and Alfred Clark.*** *Journal of Physical Chemistry*, v. 63, Feb. 1959, p. 129-133.

6413 The Nature of Substitution Reactions in Inorganic Chemistry. Nature of the central atom, ligands, and external reagent, and the geometry and coordination number of the complex are discussed in terms of their effect on rates and mechanisms. ***Ralph G. Pearson.*** *Journal of Physical Chemistry*, v. 63, Mar. 1959, p. 321-326.

6414 The Rates of Acid "Hydrolysis" of the Pentadentate Cobalt(III) Complexes of Ethylenediaminetetraacetic Acid and Hydroxyethylethylenediaminetriacetic Acid. ***Melvin L. Morris and Daryle H. Busch.*** *Journal of Physical Chemistry*, v. 63, Mar. 1959, p. 340-346.

6415 A Review of the Kinetics of the Aqueous Oxidation-Reduction Reactions of Uranium, Neptunium and Plutonium. ***T. W. Newton and S. W. Rabideau.*** *Journal of Physical Chemistry*, v. 63, Mar. 1959, p. 365-370.

6416 Binuclear Complexes as Catalysts. Nickel(II) ion reacts with tris-(2-aminoethyl)-amine in basic solution, the complex ion $[Ni_2tren_2(OH_2)]^{+}$ is formed in which there are OH^- ion bridges between two coordinated Ni ions. This complex has been shown to be a catalyst for the decomposition of H_2O_2. ***Hans B. Jonassen and V. V. Ramanujam.*** *Journal of Physical Chemistry*, v. 63, Mar. 1959, p. 411-415.

6417 Heterogeneous Flash Initiation of Thermal Reactions. Thermal reactions have been initiated at solid surfaces surrounded by a vacuum, gases, liquids, and transparent polymers, resulting in vaporization, melting, pyrolysis, explosion, and other rapid reactions. ***L. S. Nelson and L. Lundberg.*** *Journal of Physical Chemistry*, v. 63, Mar. 1959, p. 433-436.

6418* Heat of Mixing of Polybutadiene and Benzene. ***Ralph S. Jessup.*** *Journal of Research, National Bureau of Standards*, v. 62, no. 1, Jan. 1959, p. 1-5.

6419* Statistical Theory of Particle Size Distributions in Emulsions and Suspensions. A fundamental theoretical investigation. ***E. S. Rajagopal.*** *Kolloid-Zeitschrift*, v. 162, no. 2, Feb. 1959, p. 85-92.

6420* A Contribution to the Study of Double Carbides in the Systems U-Cr-C, U-Mo-C and U-W-C. Based on the examination of single crystal specimens, a structure is proposed for the isotope double carbides of $UCrC_2$, $UMoC_2$ and UWC_2. Formation of C-C bonds. Lattice constants and parameters. (*In German.*) Zur Kenntnis der Doppelkarbide in den Systemen: U-Cr-C, U-Mo-C, und U-W-C. ***H. Nowotny, R. Kieffer,, F. Benesovsky, and E. Laube.*** *Monatshefte für Chemie*, v. 89, no. 6, 1958, p. 692-700.

6421* A Contribution to the Study of the Structure of High Melting Hafnium Phases: HfC-UC, Hf_2Si, HfSi and $Hf_2Si_2(C)$. UC and HfC dissolved to a great extent at 2000 C after 2 hours, yet no homogeneous transfer occurred, Hf_2Si and HfSi crystallize as the corresponding Zr-silicides of the $CuAl_2$ or FeB type. (*In German.*) Ein Beitrag zur Struktur hochschmelzender Hafnium-Phasen: HfC-UC, Hf_2Si, HfSi und $Hf_2Si_2(C)$. ***H. Nowotny, E. Laube, R. Kieffer, and F. Benesovsky.*** *Monatshefte für Chemie*, v. 89, no. 6, 1958, p. 701-707.

6422 Thermodynamic Properties of Pure Sulfur. A method of purifying sulfur to 99.999 mole %; design of an adiabatic calorimeter for measuring heat quantities at high temperatures. *National Bureau of Standards, Technical News Bulletin*, v. 43, Feb. 1959, p. 35-37.

6423 A Chromatographic Technique for Studying the Mechanism of Surface Catalysis. Method enables the determination of heat of adsorption of a decomposing reactant. ***Kenzi Tamaru.*** *Nature*, v. 183, Jan. 31, 1959, p. 319-320.

6424 The Thermal Decomposition of Methylene Chloride. Thermal decomposition studied by the static technique of pressure-time measurement and the use of a flow system in conjunction with gas chromatographic analysis. ***M. R. Hoare, R. G. W. Norrish, and G. Whittingham.*** *Royal Society, Proceedings*, v. 250, ser. A, Mar. 10, 1959, p. 180-211.

6425 The Structure and Properties of Porous Materials. The main papers deal with fundamental theory, practical applications, and while essentially physico-chemical in character, touched also on the disciplines of geology, botany, building science, and textile and paper technology. ***D. H. Everett and F. S. Stone, editors.*** 389 pp. 1958. Academic Press, New York. (QC182 C71s)

6426* Role of Solvent in Alkyl Substituent Effects. From the energies of electronic transitions that place a high electron demand on alkyl substituents the inherent order of electron release is determined. ***W. M. Schubert, James M. Craven, Robert G. Minton, and Richard B. Murphy.*** *Tetrahedron*, v. 5, nos. 2/3, Jan. 1959, p. 194-201.

6427* Electronic Spectra of Organic Molecules and Their Interpretation. V. Effect of Terminal Groups Containing Multiple Bonds on the K-Bands of Conjugated Systems. ***A. Burawoy and J. P. Critchley.*** *Tetrahedron*, v. 5, no. 4, Feb. 1959, p. 340-351.

6428 The Chemistry of the Lower Valences of Titanium. A study was conducted to identify and characterize the lower valence states of Ti, with a particular view to establishing whether divalent compounds do in fact have stable existence. ***Thomas C. Franklin and Haig Verne Seklemian.*** *U. S. Air Force, Wright Air Development Center, WADC Technical Report* 58-349, Sept. 1958, 54 pp. (TL507 Un3:18w Vis.)

6429 Energy of Aqueous Wetting of Bulk Surfaces. Thermochemical information on liquid-solid interfaces resulting from interaction between water and various solids. ***Philip E. Berghausen, et al.*** *U. S. Air Force, Wright Air Development Center, WADC Technical Report* 58-385, Nov. 1958, 51 pp. (TL507 Un3.18w Vis.)

6430 Heats of Formation of Lanthanum Chloride, Lanthanum Sulfate, and Lanthanum Sulfate Enneahydrate. ***R. L. Montgomery.*** *U. S. Bureau of Mines Report of Investigations* 5445, 1959, 12 pp. (Tn21 Un3r Vis.)

6431* Adsorption and Catalysis on Cobaltous Oxide. The adsorption of O on cobaltous oxide was studied calorimetrically at 25 C. The decomposition of nitrous oxide over CoO was studied at temperatures up to 50 C. The reaction is limited to a small fraction of the surface and the O produced is retained by the oxide. ***F. S. Stone, R. Rudham, and R. L. Gale.*** *Zeitschrift für Elektrochemie; Berichte der Bunsengesellschaft für Physikalische Chemie*, v. 63, no. 1, 1959, p. 129-135.

6432* The Effect of Ozone on Hydrocarbon Combustion. II. The Ignition of Butylene With Oxygen. A study has been made of the critical conditions for the combustion of butylene and oxygen in a heated vessel. The lower combustion limit of this mixture is somewhat below that for the butane-oxygen mixture. The induction periods of the ignition are also shorter. The introduction of ozone considerably lowers the temperature and pressure of the ignition of butylene at the lower limit and practically nullifies the induction period. (*In Russian.*) Vliianie ozona na vosplamenenie uglevodorodov. II. Vosplamenenie butilena s kislorodom. ***N. A. Slavinskaia, S. A. Kamenetskaia, and S. Ia. Pshezhetskiĭ.*** *Zhurnal Fizicheskoi Khimii*, v. 33, no. 1, Jan. 1959, p. 45-49.

6433* Intramolecular Hydrogen Bonds and Dipole Moments of Organic Compounds. II. The Dipole Moments of Naphthols, Acylnaphthols and of Their Methyl Esters. The values of the dipole moments determined in benzene and dioxane, of 1- and 2-naphthols, of a number of acylnaphthols, and of their methyl esters bear evidence to the presence in the ortho-acylnaphthols of an intramolecular hydrogen bond. The

second naphthalene ring leads to a marked increase in the degree of conjugation of the functional groups as compared with the corresponding substituted benzenes. (*In Russian.*) Vnutrimolekuliarnaia vodorodnaia sviaz' i dipol'nye momenty organicheskikh soedinenii. II. Dipol'nye momenty naftolov atsilnaftolov i ikh metilovykh efirov. ***A. E. Lutskii and L. A. Kochergina.*** *Zhurnal Fizicheskoi Khimii*, v. 33, no. 1, Jan. 1959, p. 174-179.

6434* The Influence of Boron Fluoride on the Catalytic Activity of Aluminum Oxide and Alumosilicates. A kinetic study of the dehydration of ethyl alcohol on aluminum oxide and alumosilicate and of the cracking of cumene on alumosilicate, all treated with boron fluoride. The adsorption of BF_3, while increasing the activity of the catalysts, does not change, to a first approximation, the mechanism either of the hydration or of the cracking reactions. The treatment of aluminum oxide with boron fluoride leads to the formation of a surface chemical compound possessing a high activity with respect to the cracking of cumene. This surface compound is destroyed by the products of dehydration of ethyl alcohol. (*In Russian.*) Vliianie ftoristogo bora na kataliticheskuiu aktivnost' okisi aliuminiia i aliumosilikatov. ***T. V. Antipina and E. N. Avdonina.*** *Zhurnal Fizicheskoi Khimii*, v. 33, no. 1, Jan. 1959, p. 192-196.

See also: **6890** (diffusion in liquids and in metals and alloys); **7077** (kinetic theory of gases); **7128** (depolymerization).

COATINGS

6435 A Study of the Polymorphic Forms of Titania in Porcelain Enamels. A brief history of Ti enamels is presented. The crystallization process which takes place during firing of the enamel and the polymorphic inversion of anatase to rutile are described. The color and color stability properties of the enamel are shown to be dependent upon the stability of the crystalline modification present. ***Robert D. Shannon.*** *American Ceramic Society Bulletin*, v. 38, Mar. 1959, p. 110-116.

6436 Thermal Fracture Resistance of Ceramic Coatings Applied to Metal. I. Elastic Deformation. A study was made of the resistance to thermal fracture of four ceramic coatings of the cobalt-bearing ground-coat type applied to enameling-grade iron specimens. The study was made of coated-metal systems in the unsteady state, symmetrically cooled, and in the absence of viscous or plastic flow. Residual compressive stress in a coating is a major factor. Increased thermal shock resistance is gained by decreased coating thickness. ***J. H. Lauchner and D. G. Bennett.*** *American Ceramic Society, Journal*, v. 42, Mar. 1959, p. 146-150.

6437* Fatty Acids of Kenaf Seed Oil. Freshly extracted oil was found to contain an appreciable amount of epoxy acid as glyceride; *cis*-12,13-epoxyoleic acid was isolated. The percentage composition of the fatty acids was estimated as follows: 9-hexadecenoic 1, palmitic 19, linoleic 41, oleic 30, stearic 2, arachidic (trace), 12,13-epoxyoleic 5, undetermined 2. ***C. Y. Hopkins and Mary J. Chisholm.*** *American Oil Chemists' Society, Journal*, v. 36, Mar. 1959, p. 95-96.

6438* Determination of Composition of Vinyl Copolymers by Infrared. Copolymers of soybean vinyl ether with each of six low alkyl vinyl ethers have been investigated in the infrared. The ether band in the 1100 $cm.^{-1}$ region has been found useful in determining the composition of copolymers. ***Curtis A. Glass and Eugene H. Melvin.*** *American Oil Chemists' Society, Journal*, v. 36, Mar. 1959, p. 100-101.

6439* Methods of Analysis for Tall Oil Products. Discussion of the principal standard methods used by the American industry for the analysis and quality control of tall oil products. Review of the work of the A.S.T.M. in developing these methods. Further growth of the tall oil industry will require new and improved methods of analysis. ***Richard Herrlinger.*** *American Oil Chemists' Society, Journal*, v. 36, Mar. 1959, p. 119-124.

6440* Plastic Packaging Methods. IV. Spraying and Dipping. Spray and dip coating represent two complementary and versatile methods of packaging, which are especially useful when dealing with awkwardly shaped articles. ***D. G. Blackley.*** *Applied Plastics*, v. 1, Dec. 1958, p. 22-25.

6441 Deposition by Thermal Evaporation of Thin Films of Titanium and Zirconium for Tritium Targets. Equipment and procedure are described for applying thin films of Ti and Zr as tritium carriers to backings of Cu, Au, and Pt. ***V. D. Scott and L. W. Owen.*** *British Journal of Applied Physics*, v. 10, Feb. 1959, p. 91-93.

6442 Experimental Determination of the Atomising Efficiency of a High-Speed Spinning Disk Atomiser. Electrically driven disks of 3 and 5 cm. diameter were rotated at speeds 20,000-60,000 rev/min, and samples of an aqueous spray were analyzed for flow rates of 0.12, 0.42 and 0.77 cm^3/s. The reduction in disk speed during atomizing was determined experimentally using an electronic pulse counter and a miniature dynamometer was devised to simulate this reduction and measure the power consumed. Atomizing efficiencies were compared. ***D. J. Ryley.*** *British Journal of Applied Physics*, v. 10, Feb. 1959, p. 93-97.

6443 How Good Are Your Spraying Techniques? V. Review of application methods, equipment, and other factors. ***P. E. Grigg.*** *Ceramic Industry*, v. 72, Mar. 1959, p. 68-70.

6444* Specially Clad Steel Sheets. Use in chemistry, petroleum chemistry, and atomic engineering. (*In French.*) Les tôles plaquées d'aciers spéciaux. ***H. Lejay.*** *Chimie & Industrie (Génie Chimique)*, v. 81, no. 1, Jan. 1959, p. 1-7.

6445 Advantages of Reinforced Polyesters for Use on Highway Tank Trucks. Lighter weight than alloys of comparable strength, greater resistance to corrosive, lower coefficient of heat transfer, lower maintenance costs and lower initial cost are listed. ***James M. Brady.*** *Corrosion*, v. 15, Feb. 1959, p. 94 + 1 page.

6446 Control of Internal Corrosion of Petroleum Products Pipelines With Oil Soluble Inhibitors. Summary and discussion of the corrosion inhibitor program in a products pipeline system since its initial operation eight years ago. ***M. R. Barusch, L. G. Haskell, and R. L. Piehl.*** *Corrosion*, v. 15, Mar. 1959, p. 74-82.

6447 Protective Coatings and Linings in Neoprene. Survey of neoprene materials used in the protective coatings and lining fields—liquid and sheet neoprene, caulking compounds, putties and adhesives—and some of the practical applications to which they have been put. ***J. G. Blunn.*** *Corrosion Technology*, v. 6, Mar. 1959, p. 67-70.

6448 Neoprene and "Hypalon" for Large and Small Pipes. The article deals separately with the lining of large pipes with access to the interior and small pipes which cannot be entered for application and inspection. Each presents different problems. *Corrosion Technology*, v. 6, Mar. 1959, p. 71 + 2 pages.

6449 Spray- and Brush-Applied Neoprene Coatings. Survey of applications for this form of protection, ranging from acid agitators to marine propellers and rudders. ***P. G. Blackburn.*** *Corrosion Technology*, v. 6, Mar. 1959, p. 77-78.

6450 "Bostik" "Endurion" Anti-Corrosive Finish Claimed 40% Better Than Galvanizing for Equal Film Thickness. Details on this finish. *Corrosion Technology*, v. 6, Mar. 1959, p. 79-80.

6451* Coating Steel Pipe for Gas Service. Types of coatings and specifications. Wrapping, stockpiling, and installation of pipes. Testing and evaluating the coating. ***J. S. Dorsey and C. E. Lee.*** *Gas*, v. 35, Mar. 1959, p. 129 + 5 pages.

6452* An Engineering Approach to the Selection of Pipe Line Coating. A discussion of coatings in combating underground corrosion, covering survey, coating selection, preparing and application, and some methods of obtaining cathodic protection for a coated pipe line. ***J. A. Schauers.*** *Gas Age*, v. 123, Mar. 5, 1959, p. 35-37.

6453* Epoxy Resins for Resistant Surface Coatings. Properties and applications. *Industrial Finishing (London)*, v. 11, Feb. 1959, p. 25-27.

6454 New System for Electrostatic Paint Spraying Based on Modular Design. System is applicable to the painting of metallic products that can be handled on overhead conveyors or base-mounted conveyorized spindles. *Industrial Heating*, v. 26, Feb. 1959, p. 348-350.

6455 Vinyl-Coated Steel Sheets: Color, Pattern, Protection. *Iron Age*, v. 183, no. 11, Mar. 12, 1959, p. 128-130.

6456 Electrical Measurements of Immersed Paint Coatings on Metal. II. Effect of Osmotic Pressure and Ionic Concentration of Solution on Paint Breakdown. Depends only on osmotic pressure at first. ***D. M. Brasher and T. J. Nurse.*** *Journal of Applied Chemistry*, v. 9, pt. 2, Feb. 1959, p. 96-106.

6457 High-Temperature Metal Spraying. For mass-producing extremely hard metal parts using materials hitherto unworkable by conventional means, and/or for applying tough, heat-resistant coatings capable of withstanding temperatures above 2,760 C, the Plasma Arc Torch has been developed for commercial use. It is capable of generating controlled temperatures as high as 16,650 C. *Metal Industry*, v. 94, Feb. 13, 1959, p. 130.

6458 New Roll Coater Line for Finishing Metal Strip. Changeover of equipment by a pioneer finisher of painted strip greatly increases capacity. *Metal Products Manufacturing*, v. 16, Apr. 1959, p. 44 + 4 pages.

6459 One Coat White Direct to Steel. Reports on what is happening in porcelain enameling. *Metal Products Manufacturing*, v. 16, Apr. 1959, p. 71-72.

6460 Vinyl on Steel Embossed After Application. A new process consisting of coating steel with liquid vinyl plastisol, subjecting it to a heating cycle to harden it and, before it cools, embossing the surface with an engraved steel roll. *Metal Products Manufacturing*, v. 16, Apr. 1959, p. 75 + 1 page.

6461* Marking Metal Surfaces. I. Stencilling, engraving, transfer applications and dyed anodizing are considered. ***D. J. Fishlock.*** *Metalworking Production*, v. 103, no. 11, Mar. 13, 1959, p. 443-448.

6462* Epoxy Resins for Metal Decorating. Grades, characteristics, and properties. ***Charles H. Groff.*** *Modern Lithography*, v. 27, Mar. 1959, p. 77-79.

6463* Isophthalic Alkyds in Architectural Finishes. Isophthalic acid compared to phthalic anhydride as an alkyd intermediate. ***J. M. Stanton, Denny M. Roholt, and John Wiff.*** *Paint Industry Magazine*, v. 74, Feb. 1959, p. 7 + 2 pages.

6464* Evaluation of Colorants by Spectrophotometric Methods. The use of spectrophotometry in establishing research and control programs for developing new and improved colorants. ***W. F. Ulrich, F. Kelly, and D. C. Nelson.*** *Paint Industry Magazine*, v. 74, Feb. 1959, p. 11 + 4 pages.

6465* Urethane Coatings for Preventive Maintenance. Formulation and use of urethane coatings in paint plant maintenance. ***Edward J. Aquadro.*** *Paint Industry Magazine*, v. 74, Feb. 1959, p. 17-19.

6466* Zinc Stearate in Lacquer Sealers for Furniture Finishes. The development of zinc stearates in lacquer sealers and the problems of blooming. ***W. J. Stewart and L. W. Surano.*** *Paint Industry Magazine*, v. 74, Feb. 1959, p. 22-23.

6467 How Paints Stand up to Tropical Climates. I. Attack from corrosive gases in the atmosphere is normally not so pronounced but in marine areas salt spray may be even more acute. Improvement in standards of preparation and application are needed. ***P. Whiteley.*** *Paint Manufatcure*, v. 29, Mar. 1959, p. 87-90.

6468 Emulsion Paints. Reviews papers on new knowledge and techniques in: alkyds and polyesters, analysis and testing, anticorrosive and marine paints, emulsion paints, lacquers, pigments and colors, printing inks, synthetic resins, plant and equipment. ***A. McLean.*** *Paint Manufacture*, v. 29, Mar. 1959, p. 98-103.

6469 Fire Retardant Paints. Legislative push to make these specialty coatings required for schools and public buildings might not be an unmixed blessing. *Paint, Oil & Chemical Review*, v. 122, Mar. 19, 1959, p. 12-15.

6470 Coloured Emulsion Paints for Exterior Use. Discussion of the phenomena of "chemical fading" and "fading by chalking". Some observations and experiments are described, the results of which suggest that "fading by chalking" is indeed true fading of the colored pigment caused by destructive oxidation. ***A. D. Hibberd.*** *Paint Technology*, v. 23, Feb. 1959, p. 45-50.

6471* Calcareous Coatings—Corrosion Engineer's Offshore Ally. In salt water the protective current builds up a calcareous coating where current density is high. In some ways this "electrocoating" is superior to conventional coatings. ***Donald M. Taylor.*** *Pipe Line Industry*, v. 10, Mar. 1959, p. 36-39.

6472* Tough New Coating Can Be Tailored to Fit. Polyepoxy resin, wedded cousin of coal tar and epoxy resin, brings control of flexibility, hardness, abrasion resistance to pipe lines. ***W. E. Kemp.*** *Pipe Line Industry*, v. 10, Mar. 1959, p. 48-50.

6473 Plastisols and Organosols—Metal Coatings Supreme. The results of development and research should make possible, in the near future, direct adhesion of vinyl plastisols to metal, providing excellent corrosion protection without the need for a primer. ***Lewis D. Maines.*** *Plating*, v. 46, Mar. 1959, p. 235-238.

6474 The Full Body Dip System at American Motors. Description of the procedure. ***Vene W. Westfall.*** *Plating*, v. 46, Mar. 1959, p. 241-246.

6475 Spray Painting With Emphasis on Automation, Hot Spraying and Catalyst Spraying. Methods and equipment. ***H. A. Niedhammer.*** *Plating*, v. 46, Mar. 1959, p. 247-252.

6476 Modern Organic Coatings. Advances made in the coatings industry during the past ten years. Reasons for the persistent efforts in research to develop new types of protective and decorative coatings. Advantages of these new coatings. ***Eugene W. Kanning.*** *Plating*, v. 46, Mar. 1959, p. 253-256.

6477 Summary of Observations of Factors Influencing Adhesion of Organic Coatings to Chromium Plated Surfaces. F. L. Scott. (Reprinted from the Report of Committee B 8 on Electrodeposited Metallic Coatings, *ASTM Proceedings*, v. 58, 1958.) *Plating*, v. 46, Mar. 1959, p. 261.

6478 Finishing Tinplate in the Flat. A comprehensive review of the methods, equipment and materials that are used at the present time. ***J. T. Leonard.*** *Product Finishing*, v. 12, Mar. 1959, p. 54 + 8 pages.

6479 Re-Finishing Oil Drums. Description of a V-bond process and of the plant used in applying it. *Product Finishing*, v. 12, Mar. 1959, p. 72-76.

6480* Enamel Industry in Yugoslavia. (*In Polish.*) Przemysł emalierniczy w Jugosławii. ***Jan Buciewicz.*** *Przeglad Odlewnictwa*, v. 9, no. 1, Jan. 1959, p. 19-20.

6481* Fabrication of Plastic-Coated Steel. Properties and applications of "Stelvetite", a strip mill cold reduced steel sheet permanently covered on one side with a PVC coating 0.014 in. thick and electro-zinc coated on the reverse side. *Rubber and Plastics Age*, v. 40, Feb. 1959, p. 152-153.

6482 Laboratory Evaluation of Graphite Crucible Coatings for Vacuum Melting Uranium. Oxide and carbide coatings and methods of applying them to graphite crucibles were evaluated on a laboratory scale. Flame-sprayed $MgZrO_3$ was determined to be the best coating evaluated, limiting the average C pickup to 73 ppm for derby U charges; with slug U no pickup occurred. The flame-spray method provided a uniform coating thickness and virtually eliminated moisture and volatiles in the coatings. ***Orville R. Magoteaux, Delmer L.***

Elston, and Charles F. Hall. *U. S. Atomic Energy Commission, NLCO-759,* Oct. 24, 1958, 39 pp. (UF767 Un3.1nL Contin.)

6483 Final Report on an Engineering Study of Vacuum Metallizing. Results obtained with a series of metallic specimens coated by means of vacuum evaporation under conditions designed to produce thick deposits. ***Frank C. Perkins.*** *U. S. Office of Technical Services, PB* 131542, Dec. 17, 1956, 30 pp. (T21 Un3r Contin.)

6484* The Production of Thin Films by Evaporating Inorganic Substances in Vacuo. Summarizes experiences in carrying out evaporation processes in vacuo on a technical scale. (*In German.*) Uber die Herstellung Dünner Schichten durch thermische Verdampfung anorganischer Stoffe im Hochvakuum. ***Albert Ross.*** *Vakuum-Technik,* v. 8, no. 1, Feb. 1959, p. 1-11.

6485* Butyrate Lacquer Coat Protects Aluminum Walls Against Atmosphere Stain. Factory-applied surface coating applied to Convair Astronautics building and large insurance firm's structure for protection. *Western Metalworking,* v. 17, Feb. 1959, p. 50.

See also: **6349** (tung oil); **6895** (evaporated Ag single-crystal films); **6896** (evaporated Au coating).

CONTROL SYSTEMS, COMPUTERS, AND SYSTEMS ENGINEERING

6486* Mechanization Principles of the Analysis of Relay-Contact Circuits. Considers the principles put at the base of a special logical machine for analysis of relay circuits. The machine has a large capacity, analyses single- and multi-cycle circuits which have already been or are being designed; it has manual recording and yields the results on perforated cards. It is capable of solving logical and other problems connected with design of relay devices. (*In Russian.*) Printsipy mekhanizatsii analiza releĭno-kontaktnykh skhem. ***P. P. Parkhomenko.*** *Akademiia Nauk SSSR, Doklady,* v. 124, no. 1, Jan.-Feb. 1959, p. 83-86.

6487* Automated Transistor Production. An integrated engineering approach to product, process, and equipment design can present a better product to the market-place at lower cost. *Automation,* v. 6, Mar. 1959, p. 69-73.

6488 How Diodes Generate Functions. Also develops practical diode-biasing techniques. ***E. J. Galli.*** *Control Engineering,* v. 6, Mar. 1959, p. 109-113.

6489 4 Modern Control Systems for the Steel Industry. Here are four that perform additional functions: static control systems; data logging systems; program control systems; and director systems. ***P. A. Travisano.*** *Control Engineering,* v. 6, Mar. 1959, p. 122-126.

6490 Magnetic Head Reads Tape at Zero Speed. Describes magnetic modulator playback head, deveolped to collect original data recorded at high tape speeds, permits information playback at speeds including zero ips—with no deterioration in signal-to-noise ratio. ***Marvin E. Anderson.*** *Electronics,* v. 32, no. 10, Mar. 6, 1959, p. 58-60.

6491 Digital Memory System Keeps Circuits Simple. Magnetic disk memory, used in small low-cost digital computers with memory capacity of 50 to 100 words, uses simple control and selection circuits. Read-write circuits employ new principle, and require only one twin triode for each magnetic head. ***T. C. Chen and O. B. Stram.*** *Electronics,* v. 32, no. 11, Mar. 13, 1959, p. 130-133.

6492 A Magnetic Core Parallel Adder. A logical design using magnetic core elements which does not have the usual carry time limitations is described. The synthesis uses a truth-table technique. ***Mao-Chao Chen.*** *IRE Transactions on Electronic Computers,* v. EC-7, no. 4, Dec. 1958, p. 262-264. (TK1 In6.6e Vis.)

6493 Significant Digit Computer Arithmetic. This paper describes an alternative system which offers a means of analyzing floating point calculations more effectively and which also possesses certain advantages from an equipment standpoint. ***N. Metropolis and R. L. Ashenhurst.*** *IRE Transactions on Electronic Computers,* v. EC-7, no. 4, Dec. 1958, p. 265-267. (TK1 In6.6e Vis.)

6494 BIDEC—A Binary-to-Decimal or Decimal-to-Binary Converter. Simple, high-speed devices to convert binary, binary coded octal, or Gray code numbers to binary coded decimal numbers or vice versa is described. In simple form the conversion requires two operations per binary bit but is theoretically capable of working at one operation per bit. ***John F. Couleur.*** *IRE Transactions on Electronic Computers,* v. EC-7, no. 4, Dec. 1958, p. 313-316. (TK1 In6.6e Vis.)

6495 Time Statistics of Noise. The object of this paper is to develop the theory of time statistics and in turn to give methods for calculating them. Some elementary sample calculations of practical interest are included. ***William M. Brown.*** *IRE Transactions on Information Theory,* v. IT-4, no. 4, Dec. 1958, p. 137-144. (TK1 In6.6it Vis.)

6496 Multiple Error Correction by Means of Parity Checks. An n-place binary parity check code which corrects up to and including e errors in each code letter is fully described by its n characteristics, which are r-dimensional vectors, where r is the number of redundant binits in each code letter. ***Gerald E. Sacks.*** *IRE Transactions on Information Theory,* v. IT-4, no. 4, Dec. 1958, p. 145-147. (TK1 In6.6it Vis.)

6497 The Utility of a Communication Channel and Applications to Suboptimal Information Handling Procedures. This paper demonstrates the applicability of the functional equations of dynamic programming to information theory problems. Yielding the same results as those obtainable by Shannon's equations, the functional equations can be modified also to consider the many restrictions enforced upon information systems by the real world. ***Michael B. Marcus.*** *IRE Transactions on Information Theory,* v. IT-4, no. 4, Dec. 1958, p. 147-151. (TK1 In6.6it Vis.)

6498 Capacity of a Certain Asymmetrical Binary Channel With Finite Memory. The capacity of a certain asymmetrical binary channel is studied and it is shown that, by means of simple rules and wtih the aid of a single set of curves or a table, the calculation of the capacity can be reduced to a routine process. ***Sze-Hou Chang.*** *IRE Transactions on Information Theory,* v. IT-4, no. 4, Dec. 1958, p. 152-159. (TK1 In6.6it Vis.)

6499 The Fourth Product Moment of Infinitely Clipped Noise. This paper considers the fourth product moment, $w(\tau_1, \tau_2, \tau_3) = E\,[x(t)x(t+\tau_1)x(t+\tau_2)x(t+\tau_3)]$, when $x(t)$ is infinitely clipped noise with a mean value of zero. The results are in terms of elementary functions. A comparison is made between these models and clipped Gaussian processes. ***J. A. McFadden.*** *IRE Transactions on Information Theory,* v. IT-4, no. 4, Dec. 1958, p. 159-162. (TK1 In6.6it Vis.)

6500 A Markoff Envelope Process. It is shown that the envelope of a narrow-band Gaussian noise constitutes a first-order Markoff process if the power spectrum of the noise is the same as would be obtained from a singly tuned RLC filter with white noise at the input. ***John N. Pierce.*** *IRE Transactions on Information Theory,* v. IT-4, no. 4, Dec. 1958, p. 163-166. (TK1 In6.6it Vis.)

6501 Prediction and Filtering for Random Parameter Systems. This work generalizes the Wiener-Kolmogorov theory of optimum linear filtering and prediction of stationary random inputs. A number of engineering applications are cited. Two of these are worked out in some detail to illustrate the optimization procedure. ***F. J. Beutler.*** *IRE Transactions on Information Theory,* v. IT-4, no. 4, Dec. 1958, p. 166-171. (TK1 In6.6it Vis.)

6502 *Massachusetts Institute of Technology, Computation Center, Research and Educational Activities in Machine Computation by the Cooperating Colleges of New England, Progress Report No. 4,* Dec. 1958, 115 pp. (TK7872.C5 M38.2r Contin.)

6503 A Fast Method of Reading Magnetic-Core Memories. Describes three new circuits for fast reading of magnetic-core memories. (1) Transistors, as intermediate store elements, provide simple output stages. (2) A transistor is used as a switch to prevent parasitic voltage pulses from blocking the output stages; this appreciably shortens the "cycling time". (3) This circuit serves to stabilize the current pulses needed to read the cores and to restore the information. The operation of this circuit is based on the saturation of a ferrite ring. ***H. J. Heijn and N. C. de Troye.*** *Philips Technical Review*, v. 20, no. 7, Feb. 1959, p. 193-207.

6504* Control Engineering in a Steelworks. Reviews problems encountered in applying automatic control systems to the diversity of plant and processes occurring in a comprehensive steelworks. Approach is mainly from the practical point of view. ***M. Thomas.*** *Process Control and Automation*, v. 6, Feb. 1959, p. 50-55.

6505* Use of Linear Programming in Oil Refinery Operations. ***R. Deam.*** *Process Control and Automation*, v. 6, Feb. 1959, p. 59-64.

6506 Transform Method in Linear System Analysis. Shows what the transform method is and how it is applied to a variety of engineering problems and how the transform method can give an understanding of physical phenomena. Covers the concepts of system function, frequency response, and impulse response. ***John A. Aseltine.*** 300 pp. 1958. McGraw-Hill, New York. (QA401 As27t)

See also: **6271** (slurried reagent feed control); **6695** (machine translation); **6696** (machine translation); **6949** (reactor control systems).

ELECTRICAL ENGINEERING

6507 New Insulating Media for Hermetic Motors Require New Tests. Because hermetic motors operate in an ambient of oil and refrigerant gas at various temperatures and pressures, the qualifying tests were conducted in a chamber in which ambient conditions were simulated. ***John F. Harris and Carlo B. Sonnino.*** *ASHRAE Journal*, v. 1, Mar. 1959, p. 49-54.

6508 Timed-Signal Generator With Flexible Output. Describes a portable multiple output timing-signal generator which delivers pulses of controllable duration, amplitude and carrier content at rates of one per second in the A channel, and either one per five seconds or one per ten seconds in the B channel. ***Donald E. Minow.*** *Electronics*, v. 32, no. 10, Mar. 6, 1959, p. 52-53.

6509 Electricity From Geothermal Steam. Describes the utilization of geothermal steam on a large scale for the production of electricity, in the North Island of New Zealand. At stage 1, 69 MW of turbine plant is being installed, and a further extension (stage 2), which will bring the generating capacity up to 150 MW, has been authorized. ***E. L. E. Wheatcroft.*** *Institution of Electrical Engineers, Journal*, v. 5, no. 50, Feb. 1959, p. 83-87.

6510* A New Method of Determining Rotor Leakage Reactance and Resistance of a Three-Phase Induction Motor. Describes a new method of determining the rotor leakage reactance and resistance of a 3-phase induction motor. A comparison of the test results obtained by the new and conventional methods justifies the determination of rotor constants by the new method. ***M. V. Deshpande and T. R. Subrahmanyan.*** *Institution of Electrical Engineers, Proceedings*, v. 106, pt. A, no. 25, Feb. 1959, p. 46-50.

6511* The Application of Transistors to Phase-Comparison Carrier Protection. The results set out in the paper demonstrate the feasibility of using transistors as circuit elements in a carrier scheme of protection. The system of protection which has been devised is suited to all the abnormal power-system conditions which may be experienced. The test results showed that the functional use of the transistor mainly as a switching on-off element is clearly very satisfactory. ***Colin Adamson and E. A. Talkham.*** *Institution of Electrical Engineers, Proceedings*, v. 106, pt. A, no. 25, Feb. 1959, p. 51-63.

6512 Report: Insulation in the SPE Conference. Much of interest to the electrical/electronic insulation industry was discussed at the 15th annual technical conference held by the Society of Plastics Engineers in New York City recently. Eight papers given at the convention are summarized here. *Insulation*, v. 5, Mar. 1959, p. 13-17.

6513 Three Decades of Progress in Electrical Insulation. I. Introduction, Theory, and Materials. The last 30 years cover a period marked with outstanding advances in certain areas of the field of electrical insulation. This period begins with what might be termed the "synthetic chemical age" and ends with the beginning of the "space age". It is the purpose of this review to record briefly the progress made during this period in: (1) the theoretical phase of the field, (2) the development of new materials, (3) the revision of insulation temperature standards, and (4) the application of new materials to power equipment. ***Leo J. Berberich.*** *Insulation*, v. 5, Mar. 1959, p. 18-23.

See also: **6486** (relay circuit analysis); **6680** (self-regulating alternator); **6864** (steel for generator rotors); **7151** (electrical conductivity of irradiated polymers); **7158** (conductive plastics).

ELECTROCHEMISTRY

6514 Electrochemical Reaction Kinetics and the Zero Points of Metals. In contemporary electrochemistry, wide use is made of the scale of ϵ-potentials, for which the potential of some standard electrode is taken as a basis. The hydrogen electrode is most often selected as the electrode with zero potential. Any system of so-called "absolute" potentials is also related to the same scale. Examples of the application of the scale of Ψ-potentials in the examination of different problems on the kinetics of electrochemical processes are: the electrolytic reduction of organic compounds; the electrodeposition of metals and metallic overvoltage; metal corrosion and inhibiting action. ***L. I. Antropov.*** Paper from "The Academy of Sciences of the USSR Division of Chemical Science, Reports of the Fourth Soviet Conference on Electrochemistry, October 1-6, 1956", Consultants Bureau, Inc., New York. 1958, p. 3-4. (QD552 So89ttr)

6515 The Comparative Characteristics of the Processes of Electrodeposition of Alloys of Molybdenum and Tungsten With Metals of the Iron Group. In recent years special attention has been given to methods for the preparation and study of the properties of alloys of the transition metals—Mo, W, Cr, and Ti—with metals of the Fe group. One possible method for preparing the alloys is by the electrochemical method. A study has been made of the conditions for the deposition of binary and ternary alloys of W and Mo with Ni, Co, and Fe from ammino- and oxyacido-ammino-electrolytes. It has been established that molybdenum and tungsten show several common properties when deposited as alloy components; at the same time, however, considerable differences in their behavior are observed. They have the following points in common: (1) the alloys of both metals can be deposited from electrolytes of the same type; (2) the percentage concentration of W and Mo in electrolytic deposits, other conditions being equal, is determined by the nature of the iron group metal being deposited simultaneously; it is a maximum with Fe and a minimum with Ni. (3) The electrolytically deposited alloys are always one-phase solid solutions. The suggestion has been put forward that the main reason for the electrolytic deposition of alloys of Mo and W with the metals of the Fe group is the formation of supplementary bonds by the d-electrons, shown in a considerable gain in energy and a shift of the deposition potentials in a positive direction relative to their standard potentials. ***T. F. Frantsevich-Zabludovskaia and A. I. Zaiats.*** Paper from "The Academy of Sciences of the USSR, Division of Chemical Science, Reports of The Fourth Soviet Conference on Electrochemistry, Oct. 1-6, 1956". Consultants Bureau, Inc., New York. 1958, p. 56. (QD552 So89ttr)

6516 The Mechanism of the Deposition of Nickel-Molybdenum Alloys. An examination has been made of the conditions for the simultaneous deposition of certain cations and the influence of alloy formation on the equilibrium and non-equilibrium parts of the deposition potentials of the metals. It has been shown on the basis of literature data that the change in the equilibrium deposition potentials of two metals at identical percentage alloy composition is greater, the greater the difference in their normal potentials. These changes, however, always constitute only a part of the difference in normal potentials and therefore cannot be the only factor responsible for the simultaneous deposition. It has been established that in the simultaneous deposition of Mo and Ni, the main energy gain in the deposition of the Mo falls on a reduction in the overvoltage of its deposition as a result of alloy formation, and not on a reduction in equilibrium potential. The deposition of pure Mo does not take place, as a result of the high overvoltage of deposition of Mo on Mo and the low overvoltage of H liberation on Mo. It has been shown that the rates of liberation of H and Ni are functions of the percentage composition of the Ni-Mo alloy deposited on the cathode. It has been shown that there are no grounds for the suggestion that the reason for the simultaneous deposition of Mo and Ni is the discharge of Ni-Mo complexes. ***A. I. Krasovskii.*** Paper from "The Academy of Sciences of the USSR, Division of Chemical Science, Reports of The Fourth Soviet Conference on Electrochemistry, Oct. 1-6, 1956". Consultants Bureau, Inc., New York, 1958, p. 57. (QD552 So89ttr)

6517 An Oscillographic Study of the Cathodic Process in the Electrodeposition of Chromium. The electrodeposition of chromium is one of the most complex and at the same time insufficiently studied processes of electrolytic metal deposition. The application of the usual methods for studying electrode processes has not yet led to an explanation of the mechanism of this process. In the present work a method using loop and electron oscillographs was used to study the electrode process. We used the experimental method applied by A. T. Bagramian to the study of the chromium plating process, namely the recording of the current strength-time curves. A comparison of the oscillographic curves and the results of microscopic studies has been used as the basis for a discussion of the question of the relationship between the electrodeposition conditions and the peculiar features of the chromium structure. ***M. A. Shluger.*** Paper from "The Academy of Sciences of the USSR, Division of Chemical Science, Reports of the Fourth Soviet Conference on Electrochemistry, Oct. 1-6, 1956", Consultants Bureau, Inc., New York. 1958, p. 59. (QD552 So89ttr)

6518 Bright Copper Plating of Articles With a Relief, From Acid Baths. Advantages of bright copper plating from acid baths over polishing + electroetching of protective-decorative three-layer copper deposits as used, for example, on printshop "electros". Experimental, pilot-plant and full-scale plant procedures; results obtained. ***V. P. Persiantseva, N. T. Kudryavtsev, and V. M. Kalb.*** *Henry Brutcher Translation No.* 4357, 9 pp. (From *Metallovedenie i Obrabotka Metallov*, 1958, no. 9, Sept., p. 42-46.) Henry Brutcher, Altadena, Calif.

6519 Universal Electrolyte for the Polishing of Stainless and Heat-Resisting Steels, Low-Carbon Steels and Titanium Alloy VT-5. Development of a universally applicable electropolishing technique for welds in various steels, etc. Recommended electrolyte compositions; voltages, current densities, and cathode-anode distances. ***G. I. Parfessa and V. A. Sidlyarenko.*** *Henry Brutcher Translation No.* 4421, 3 pp. (From *Avtomaticheskaya Svarka*, v. 11, no. 7, 1958, p. 83-84.) Henry Brutcher, Altadena, Calif.

6520 Anodised Aluminium Windings. Commercial production at Tyne Chemical Co. Ltd., River Drive, South Shields, where the company has recently developed technique to a high degree of mechanical and electrical efficiency. Technical advantages and production limitation are discussed. *Light Metals*, v. 22, Feb. 1959, p. 55.

6521* New Process Plates Chromium on Aluminum. With no intermediate metallic deposition of Cu, Ni, or zincate needed, process eliminates the possibility of galvanic action and also prevents undesirable electrolytic couples. Provides high anti-abrasive action and affords high torsional and impact load with a very low coefficient of friction. *Modern Metals*, v. 15, no. 1, 1959, p. 59.

See also: **6267** (electrodialysis); **6477** (adhesion of organic coatings to Cr plate).

ELECTRONICS

6522* Dependability of Military Equipment: a Systems Approach. To aid the equipment designer, effects of modularization and other approaches to increased maintainability and reliability are worked out in an example of complex electronic devices, using statistical methods. ***J. G. Wohl.*** *Electrical Manufacturing*, v. 63, Mar. 1959, p. 96-100.

6523 Solid-State Thyratrons Available Today. Presents tabulation of solid-state thyratrons, commercially available at time of writing, with a discussion of important features and what to look for in future. ***T. P. Sylvan.*** *Electronics*, v. 32, no. 10, Mar. 6, 1959, p. 50-51.

6524 Current Integration With Solion Liquid Diodes. Complementing transistors and vacuum tubes in control applications, the solion shows promise as a useful and versatile device. Units for integrating fluid pressures, flows and electrical currents are described. ***R. N. Lane and D. B. Cameron.*** *Electronics*, v. 32, no. 9, Feb. 27, 1959, p. 53-55.

6525 Slot-Antenna Array for Missiles and Aircraft. Describes how a simple modification of a linearly polarized slot radiator achieves circular polarity for antenna array used on missile. Signal mismatch, caused by motion of missile in flight is minimized, making ideal missile array. ***E. J. Wilkinson.*** *Electronics*, v. 32, no. 9, Feb. 27, 1959, p. 56-57.

6526 UHF Transistor Data. A tabulation of commercially available transistors which are capable of operating in the UHF region of 300 to 3,000 mc. ***Henry Tulchin.*** *Electronics*, v. 32, no. 10, Mar. 6, 1959, p. 57.

6527 Carcinotron Harmonics Boost Receiver Range. Superheterodyne receiver affords continuous frequency coverage from 30 mc to greater than 75 kmc by application of harmonic mixing. Carcinotron that is voltage-tunable from 2 to 4 kmc serves as local oscillator for two separate r-f systems, providing exceptionally broad tuning range. ***C. H. Currie.*** *Electronics*, v. 32, no. 9, Feb. 27, 1959, p. 58-61.

6528 Two-Terminal Solid-State Switches. Contains tabulation of important characteristics of commercially available *pnpn* and *pnpm* semiconductor switching diodes, and points out difference between symbols. ***T. P. Sylvan.*** *Electronics*, v. 32, no. 9, Feb. 27, 1959, p. 62-63.

6529 Improved R-C Oscillator. Direct-current coupled multiple-feedback oscillator gives excellent amplitude stability with low distortion in the output waveform. ***Leon H. Dulberger.*** *Electronics*, v. 32, no. 10, Mar. 6, 1959, p. 62.

6530 Propagation of a Ground Wave Pulse Around a Finitely Conducting Spherical Earth From a Damped Sinusoidal Source Current. The form of the wave can be calculated by a direct quadrature evaluation of the Fourier integral. The method is illustrated in this paper by a calculation of the transient field radiated by the particular case of the damped sinusoidal source current dipole. The form of the transient signal was found to be dispersed by the propagation medium. The most noteworthy attribute of this dispersion is a stretching of the period of the wave so that the form of the source is somewhat obscured by the filtering action of the medium. ***J. R. Johler and L. C. Walters.*** *IRE Transactions on Antennas and Propagation*, v. AP-7, no. 1, Jan. 1959, p. 1-10. (TK1 In6.6ap Vis.)

6531 Spherically Symmetric Lenses. A design procedure is given for finding the index variation of a spherically (or cylindrically) symmetric lens which will produce, with some restrictions, any desired shaped beam pattern. Applications are made to a broad beam Luneberg lens, a bistatic Luneberg

reflector, and a bistatic Eaton-Lippmann lens, and other examples are worked out. The practical importance of the index singularity at the center of lenses of the Eaton-Lippman type is treated. ***Alan F. Kay.*** *IRE Transactions on Antennas and Propagation*, v. AP-7, no. 1, Jan. 1959, p. 32-38. (TKL In6.6ap Vis.)

6532 On the Design of Some Rhombic Antenna Arrays. ***A. A. De Carvalho Fernandes.*** *IRE Transactions on Antennas and Propagation*, v. AP-7, no. 1, Jan. 1959, p. 39-46. (TK1 In6.6ap Vis.)

6533 Radiation Field of an Elliptical Helical Antenna. Rigorous expressions for the radiation field of a helical antenna of elliptical shape are derived on the assumption of a traveling-wave type of current distribution along the helix conductor. ***J. Y. Wong and S. C. Loh.*** *IRE Transactions on Antennas and Propagation*, v. AP-7, no. 1, Jan. 1959, p. 46-52. (TK1 In6.6ap Vis.)

6534 The Rectangular Loop Antenna as a Dipole. An integral equation for the current in a rectangular loop of wire is derived for a loop that is driven by two generators located at the centers of one pair of opposite sides. It is shown that the solution for the rectangle of wire reduces to that of the symmetrically driven folded dipole when one dimension is made electrically small and to a section of transmission line driven simultaneously at both ends when the other dimension is made small. ***Ronald King.*** *IRE Transactions on Antennas and Propagation*, v. AP-7, no. 1, Jan. 1959, p. 53-61. (TK1 In6.6ap Vis.)

6535 Properties of Slotted Dielectric Interfaces. A theoretical analysis of slotted dielectric interfaces based on an application of the Rayleigh-Ritz method is presented. Numerical results are given which show that the slotted dielectric interface behaves essentially as a homogeneous anisotropic dielectric interface. ***Robert E. Collin.*** *IRE Transactions on Antennas and Propagation*, v. AP-7, no. 1, Jan. 1959, p. 62-73. (TK1 In6.6ap Vis.)

6536 Traveling-Wave Cylindrical Antenna Design—A Graphical Synthesis Method. A simple graphical method is given for the synthesis of a special line source system. The elements of the line source system are excited with equal amplitudes and continuously increasing phases. The sources lie on a cylindrical surface. The shape of this surface depends on the given pattern functions. ***Peter Foldes.*** *IRE Transactions on Antennas and Propagation*, v. AP-7, no. 1, Jan. 1959, p. 74-80. (TK1 In6.6ap Vis.)

6537 Theoretical Research on Tropospheric Scatter Propagation in the United States, 1954-1957. In the past three years, the emphasis of theoretical research has shifted from the analysis of the average signal level to the analysis of the signal statistics and to the underlying hydrodynamics of atmospheric turbulence. ***H. Staras and A. D. Wheelon.*** *IRE Transactions on Antennas and Propagation*, v. AP-7, no. 1, Jan. 1959, p. 80-87. (TK1 In6.6ap Vis.)

6538 U.S.A. National Committee Report URSI Subcommission 6.3 Antennas and Waveguides, and Annotated Bibliography. Fields included in this survey are broad-band antennas, wide-angle microwave optics, antennas for ionospheric scatter propagation, traveling-wave antennas, slot radiators, diffraction, and scattering theory. ***H. V. Cottony, R. S. Elliott, E. C. Jordan, V. H. Rumsey, K. M. Siegel, J. R. Wait, and O. C. Woodyard.*** *IRE Transactions on Antennas and Propagation*, v. AP-7, no. 1, Jan. 1959, p. 87-98. (TK1 In6.6ap Vis.)

6539 A New AGC Circuit. Shows a-g-c control equal to one grounded-emitter stage plus an overload diode can be obtained from a single grounded-base state. Saves diode cost with no performance loss. ***Frank J. Banovic and Richard L. Miller.*** *IRE Transactions on Broadcast and Television Receivers*, v. BTR-5, no. 1, Jan. 1959, p. 5-9. (TK1 In6.6b Vis.)

6540 Television Receiver Color Decoder Design. The report presents: (1) a discussion of design principles internal to the decoder; (2) a discussion of external or environmental factors such as IF shapes and burst gating; (3) a complete circuit diagram; and (4) measurements of performance characteristics. ***Donald Richman.*** *IRE Transactions on Broadcast and Television Receivers*, v. BTR-5, no. 1, Jan. 1959, p. 27-45. (TK1 In6.6b Vis.)

6541 Detection of Asymmetric Sideband Signals in the Presence of Noise. The first part of this paper analyzes three methods of detection of signals contaminated by fluctuation noise: (1) linear envelope detectors; (2) product detectors; (3) exalted carrier detectors. The second part of this paper analyzes the effects of impulse noise on the detection of asymmetric sideband signals. It is shown that product detectors eliminate the rectification of the noise envelopé found in envelope detectors. ***Tomomi Murakami and Richard W. Sonnenfeldt.*** *IRE Transactions on Broadcast and Television Receivers*, v. BTR-5, no. 1, Jan. 1959, p. 46-75. (TK1 In6.6b Vis.)

6542 On Calculating the Current Gain of Junction Transistors With Arbitrary Doping Distributions. Presents a somewhat extended theory from which the gain can be found approximately for any distribution of resistivity in the transistor. ***H. L. Armstrong.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 1, Jan. 1959, p. 1-5. (TK1 In6.6ed Vis.)

6543 A Gun and Focusing System for Crossed-Field Traveling-Wave Tubes. An analysis of electron flow through the fringing-field region, including the effect of space charge, is presented. Results are also presented from tests on an experimental, demountable tube used to test the focusing scheme. ***O. L. Hoch and D. A. Watkins.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 1, Jan. 1959, p. 18-27. (TK1 In6.6ed Vis.)

6544 Germanium P-N-P-N Switches. The electric field in the base of a wide-base transistor is shown to be responsible for the appreciable current gains that may be exhibited by this type of structure. Since the field is produced by the emitter current, the current gain is a function of current. This effect is utilized to make germanium *p-n-p-n* diode and triode switches. ***I. A. Lesk.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 1, Jan. 1959, p. 28-35. (TK1 In6.6ed Vis.)

6545 The Design and Characteristics of a Megawatt Space-Harmonic Traveling-Wave Tube. The tube described in this paper has a pulsed output power of one megawatt with 9.6% bandwidth, where bandwidth is defined as the 3db points for saturation power. Saturation gain is about 20 db which is 6 db below the low-level gain. ***M. Chodorow, E. J. Nalos, S. P. Otsuka, and R. H. Pantell.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 1, Jan. 1959, p. 48-53. (TK1 In6.6ed Vis.)

6546 The Effect of Space Charge on Bunching in a Two-Cavity Klystron. The various available theories are reviewed and compared with new experimental data on the subject. It is found that there is 25% loss of bunching efficiency at the drift length, i.e., 90 degrees of an effective plasma wavelength. Reasoning qualitatively from these measurements, the optimum drift lengths for a multicavity klystron are suggested to be: 90°: 90°:···:65°-45°: 30°. ***T. G. Mihran.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 1, Jan. 1959, p. 54-64. (TK1 In6.6ed Vis.)

6547 Effect of Transient Voltages on Transistors. Analytical expressions are derived to show the different transistor parameters and circuit constants which influence the magnitude of transient energy. By far the most important parameter is the sustain voltage. It was found that any operation near or above this voltage may be damaging to the transistor unless due precaution is taken. ***H. C. Lin and W. F. Jordan, Jr.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 1, Jan. 1959, p. 79-83. (TK1 In6.6ed Vis.)

6548 Strapped Bifilar Helices for High-Peak-Power Traveling-Wave Tubes. A method of increasing the peak-pulsed power output of broad-band traveling-wave tubes is described. The method involves the use of a modified bifilar helix for the slow-wave structure. Both analytical and experimental results regarding the behavior of the structures are presented showing the propagation characteristics. ***D. A. Watkins and D. G. Dow.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 1, Jan. 1959, p. 106-114. (TK1 In6.6ed Vis.)

6549 Theory of Magnetostrictive Delay Lines for Pulse and Continuous Wave Transmission. The theory presented is an analytic formulation of the characteristics of magnetostrictive delay lines. A limited analysis of the theory is also given and, assuming linear relationships between the elastic and magnetic variables involved, equations are derived that give analytic forms for the magnetostrictive and inverse magnetostrictive effect. ***Roscoe C. Williams.*** *IRE Transactions on Ultrasonics Engineering, PGUE-7,* Feb. 1959, p. 16-38. (TK1 In6.6u Vis.)

6550 Junction Transistor Electronics. Emphasizes characteristics and circuit applications. ***Richard B. Hurley.*** 473 pp. 1958. John Wiley & Sons, New York. (TK7872.T73 H93j)

6551* Principles of Microwave Interactions With Ionized Media. I. Plasma Resonance. *R. F. Whitmer.* *Microwave Journal,* v. 2, Feb. 1959, p. 17-19.

6552* Systems Applications of Ferrite Circulators. The advantages of this type of duplexer (in conjunction with a crystal protecting TR tube) are inherent magnetron-to-load isolation, improved high powered insertion loss (over a combination of tube type duplexing plus isolators) and reduction of power level to TR tubes, making possible higher powered operation of existing TR tubes, and improved recovery time characteristics with some minor improvement in tube life. ***Tore N. Anderson.*** *Microwave Journal,* v. 2, Feb. 1959, p. 20-23.

6553* Using the Smith Diagram. II. *George C. Southworth.* *Microwave Journal,* v. 2, Feb. 1959, p. 24-30.

6554* Temperature Compensation of Ferrite Isolators. May be accomplished by the use of a low Curie temperature material external to the waveguide which acts as a temperature variable element to increase or decrease the applied magnetic field as required by the isolator configuration. ***Gershon Wheeler and Paul Rajcok.*** *Microwave Journal,* v. 2, Feb. 1959, p. 31-32.

6555 Transmission-Line Analogue of a Drift Transistor. A transmission line that is governed by the same differential equations as a drift transistor is discussed. It provides a relatively simple way of deriving the base transport parameters and the small-signal equivalent circuit of the transistor, without solving the differential equations explicitly. ***J. te Winkel.*** *Philips Research Reports,* v. 14, no. 1, Feb. 1959, p. 52-64.

6556 Proceedings of the 1958 International Conference on Semiconductors. *Physics and Chemistry of Solids,* v. 8, Jan. 1959, 552 pp.

6557* On the Theory of Waveguides of Varying Cross Section. Distribution of electromagnetic waves is considered in a plane waveguide whose cross section varies slowly but by a finite value. The method used makes it possible to calculate, in principle, the effects of wave reflection and scattering with accuracy up to any degree of the small parameter. (*In Russian.*) K teorii volnovodov peremennogo secheniia. ***V. L. Pokrovskiĭ, F. R. Ulinich, and S. K. Savvinykh.*** *Radiotekhnika i Elektronika,* v. 4, no. 2, Feb. 1959, p. 161-171.

6558* Distribution of Electromagnetic Waves in Curved Loaded Waveguides. Propagation of electromagnetic waves is investigated in curved waveguides which are loaded with diaphragms or are partially filled with a dielectric. The possibility of the propagation of the LH-type waves with definite phase velocities within them is analyzed and the nonuniformity of the electric field longitudinal component is evaluated. (*In Russian.*) Rasprostranenie elektromagnitnykh voln v izognutykh nagruzhennykh volnovodakh. ***A. N. Didenko.*** *Radiotekhnika i Elektronika,* v. 4, no. 2, Feb. 1959, p. 172-180.

6559* Attenuation of Electromagnetic Waves Propagating Along Helix Wire Line. Characteristic equation is derived for determining the propagation constant in a helix line, made of a round wire of finite conductivity, depending upon helix geometry and wave length. Approximate formulas are derived for calculating phase velocity and attenuation. An exemplary calculation of a helix line is given. (*In Russian.*) Zatukhanie elektromagnitnykh voln, rasprostraniaiushchikhsia vdol' provolochnoĭ spiral'noĭ linii. ***S. Kh. Kogan.*** *Radiotekhnika i Elektronika,* v. 4, no. 2, Feb. 1959, p. 181-186.

6560* Investigation of the Character of Rapid Fadings of Radio Signals Along Near-Earth Lines of Medium Length. Describes the results of the investigation of amplitude fluctuations of waves in the 3 cm band during propagation along the near-earth visibility line. As a result, a preliminary evaluation was obtained of the effect of the underlying surface on the formation of amplitude fluctuations of the reflected signal. The results can be used for passive retranslation of signals and for radar location of terrestrial targets. (*In Russian.*) Issledovanie kharaktera bystrykh zamiraniĭ radiosignalov na prizemnykh trassakh sredneĭ protiazhennosti. ***A. A. Semenov and G. A. Karpeev.*** *Radiotekhnika i Elektronika,* v. 4, no. 2, Feb. 1959, p. 187-194 + 1 plate.

6561* Experimental Investigation of the Generator of Unretarded Backward Wave. Describes a model of an experimental h-f oscillator based on the interaction between the electron beam and the electromagnetic wave having phase velocity equal to the velocity of light. The possibility of frequency modulation of the oscillator was also investigated and the experimental results are described. (*In Russian.*) Eksperimental'noe issledovanie generatora nezamedlennoĭ obratnoĭ volny. ***K. Ia. Lizhdvoĭ.*** *Radiotekhnika i Elektronika,* v. 4, no. 2, Feb. 1959, p. 212-217.

6562* Traveling-Wave Tube Oscillator With Electronic Phase Shifter. The simplest relationships are derived for the frequency of the T-W tube oscillator which has an electronic phase shifter between the helices of the tube. Experimental results have shown the presence of several oscillation zones in the frequency band near 3000 MC. The electronic tuning range reached 4% and was limited by oscillations of the adjacent types. (*In Russian.*) Generator na lampe begushcheĭ volny s elektronnym fazovrashchatelem. ***V. P. Tychinskiĭ and V. G. Fedorov.*** *Radiotekhnika i Elektronika,* v. 4, no. 2, Feb. 1959, p. 241-245.

6563* Three-Resonance Klystron Frequency Multipliers. Three-resonance frequency-multiplicating klystrons with preliminary signal amplification and varying frequency multiplicity factor are described. Some theoretical and experimental results are compared. Experimental results have shown three-resonance frequency multipliers to be superior. (*In Russian.*) Trekhrezonatornye klistronnye umnozhiteli chastoty. ***A. D. Sushkov.*** *Radiotekhnika i Elektronika,* v. 4, no. 2, Feb. 1959, p. 246-252.

6564* Frequency Transformation With Reflex Klystron. The possibility of using reflex klystrons for frequency transformation in the super-high frequency range is analyzed. Experimental results obtained under various operating conditions have shown satisfactory agreement with theory. (*In Russian.*) Preobrazovanie chastoty na otrazhatel'nom klistrone. ***E. N. Bazarov and M. E. Zhabotinskiĭ.*** *Radiotekhnika i Elektronika,* v. 4, no. 2, Feb. 1959, p. 253-261.

6565* On One Method of Measuring Electron Conductivities of Plane Electrode Tubes. A method is described for measuring internal conductivities of electron tubes by means of a measuring line connected to a two-terminal pair network containing tube. The method is particularly convenient when the scattering of "cold" parameters of tubes is large. (*In Russian.*) Ob odnom metode izmereniia elektronnykh provodimosteĭ ploskoelektrodnykh lamp. ***A. I. Kostienko.*** *Radiotekhnika i Elektronika,* v. 4, no. 2, Feb. 1959, p. 313-320.

6566* Limit Sensitivity and Noise Spectrum of Plane Germanium Photodiodes. The results are described of an experimental investigation of the limit sensitivity, absolute magnitude, and noise spectrum distribution of plane Ge photodiodes developed at the LFTI. The sensitivity threshold of the diodes was of the order of 10^{-10} lm/sec$^{1/2}$ with the light beam modulation frequency of 70 cps. (*In Russian.*) Predel'naia chuvstviteľnost' i spektr shuma ploskostnykh germanievykh fotodiodov. ***L. Ia. Perova.*** *Radiotekhnika i Elektronika,* v. 4, no. 2, Feb. 1959, p. 330-334.

6567 Single-Line-Scan Television. Describes equipment constructed to demonstrate the practicability of using a Vidicon camera tube for measuring the space orientation of spin stabilized Aerobee-Hi research rockets. Laboratory photographs which were obtained by means of a spinning, line-scan camera demonstrated that this method can be used to obtain pictures

whose quality is similar to those of standard television. ***F. H. Harris and J. Ainsworth.*** *Review of Scientific Instruments*, v. 30, Feb. 1959, p. 76-78.

6568 Log Periodic Antennas Break Bandwidth Barriers. ***R. H. DuHamel.*** *Space/Aeronautics*, v. 31, no. 3, Mar. 1959, p. 148-151.

6569 Study of X-Band Propagation Beyond Line of Sight. X-band tropospheric scatter measurements were made to determine the feasibility of a proposed 100-mile X-band link. The data and results are given for signal strength measurements up to 77 miles. It was concluded that the increased gain necessary to meet the reliability requirements for the proposed X-band link would be prohibitive at the present time. ***Joseph W. Page and Herbert E. Whitney.*** *U. S. Air Force, Cambridge Research Center, AFCRC-TR-58-164*, July 1958, 27 pp. (TK7800 Un3.12b Contin.)

6570 A Stabilized Transistor Oscillator. Some circuit equations for conditions of oscillation and fractional frequency deviation from the tuned circuit frequency are derived, and the results of several designs are evaluated. It is shown that stabilities of ± 1 part in 10^6 are easily obtainable with simple circuits. ***Thomas F. Marker.*** *U. S. Atomic Energy Commission, SC-4257(TR)*, Jan. 1959, 19 pp. (UF767 Un3.1sc Contin.)

See also: **6441** (Ti and Zr for tritium targets); **6487** (automated transistor protection); **6490** (magnetic modulator playback head); **6508** (timing-signal generator); **6658** (automatic ocean weather monitors); **6702** (electron velocity spectrograph); **6705** (pulse preamplifier); **7090** (masers); **7111** (propagation on a helix).

ENGINEERING ECONOMICS

6571* Cost Finding and Control. Classification of Overhead. The two classes of overhead expense are simple to measure by the week, month or year. This is simple accounting. The difficult problem is to determine their allocation to specific products. This article attempts to break down overhead expenses with reference to corrugated box manufacture. ***Spencer A. Tucker.*** *Boxboard Containers*, v. 77, Apr. 1959, p. 34-36.

6572 Delaware River Gets a Master Plan. The most exhaustive study ever conducted on the Delaware River's vast water resources is heading into the home stretch. Its findings and recommendations should play key roles in the industrial future of the whole area. *Chemical and Engineering News*, v. 37, no. 9, Mar. 2, 1959, p. 146 + 5 pages.

6573 Tight Schedules Speed Product Launching. Archer-Daniels-Midland Co. (ADM) will shortly complete final phases of a tight timetable designed to launch its new, water-base paint resin, Arolon-1000, into the marketplace. *Chemical Week*, v. 84, no. 13, Mar. 28, 1958, p. 47 + 1 page.

6574 Coal for Steel—The Future of Direct Reduction. The change-over to direct reduction as the basis for making the Nation's pig-iron—for reasons cited in this article—will most likely be evolutionary, not revolutionary. However, direct reduction is backed by aggressive research and development effort and limited commercial use has already begun with immediate opportunities for growth. ***W. A. Raleigh, Jr.*** *Coal Age*, v. 64, Mar. 1959, p. 66-71.

6575* Soviet Union Announces Electronic Computing Centers for Over-All Economic Planning. Soviet economists expect to reach the point where they will be able to determine quickly the effect of individual phenomena on the economy of the country as a whole. ***Rudolph Sobotka.*** *Computers and Automation*, v. 8, Feb. 1959, p. 26-27.

6576 Economics for the Mineral Engineer. Based on practical mining experience at executive managerial and consultative levels in several countries and with both small and large companies, this book is written primarily for students of mineral dressing, but connects their specialized field of work with those of mine management and company administration. The objective is a simple contribution to the literature of mineral dressing economics. ***Edmund J. Pryor.*** 254 pp. 1958. Pergamon Press, New York. (TN153 P95e)

6577* Britain's Fuel and Energy Needs: the Next Ten to Twenty Years. The demand for fuel and power will increase, with fluctuations, from the present coal equivalent of between 250 and 255 million tons a year to reach 275 to 280 million tons by 1968-70, or by the equivalent of about 25 million tons. Three-fifths of this increase will be provided by electricity from nuclear power stations and two-fifths by the use of an additional 6 million tons of petroleum oils. ***A. Parker.*** *Institute of Fuel, Journal*, v. 32, Mar. 1959, p. 98-101.

6578 The Awakening Dragon. Summarizing reports from Chinese and free world sources, a report is given on the industrial growth of Communist China during the last few years, as succeeding five-year plans seek to make use of the tremendous population and resource potential which could build China into a top-position industrial country. *Journal of Metals*, v. 11, Mar. 1959, p. 182-183.

6579* The Automotive Industry: A Study in Industrial Location. ***Neil P. Hurley.*** *Land Economics*, v. 35, no. 1, Feb. 1959, p. 1-14.

6580* Russian Foreign Trade 1956-1957. Covers metal and mineral statistics. *Metal Age*, 1959, no. 85, Feb., p. 1 + 1 page.

6581* An Analysis of the Lead-Zinc Import Quota System. ***C. E. Schwab.*** *Metals*, v. 29, no. 8, Feb. 1959, p. 8-9.

6582* Silver—Its Uses and Prospects. Industrial uses accounted for better than half of the estimated 250,500,000 toy ounces of silver consumed in the free world in 1958. Furthermore, industrial uses are expected to continue to expand in the future so that the traditional use of silver in the arts will become less and less important to the producers of silver as an outlet for their product. ***Ralph L. Wilcox.*** *Metals*, v. 29, no. 8, Feb. 1959, p. 10-12.

6583* United States Mineral Output. Preliminary report of the United States Bureau of Mines for 1958. *Mining Magazine*, v. 100, no. 2, Feb. 1959, p. 68.

6584 O.E.E.C. Statistical Bulletins. Industrial Statistics, 1900-1957. Production—Consumption—Imports—Exports. The O.E.E.C. Statistical Bulletins are designed to provide, in a readily accessible form, a general statistical information on the economies of the 17 European conutries which are members of the organization and of the countries associated with its work (United States, Canada, Spain, and Yugoslavia). In a relatively small volume, these bulletins bring together the main data from a great number of national publications and include in addition a number of original statistics of particular interest for the study of international economic problems. (*In French and English.*) Bulletins statistiques de l'OECE. Statistiques industrielles, 1900-1957. Production—consommation—importations—exportations. 174 pp. 1958. Organization for European Economic Cooperation, Paris. (HC240 Or3i Over.)

6585 Planning New Products. Seventeen papers reprinted from *Machine Design* on basic steps in developing an idea into a profitable production item. ***Philip Marvin.*** 102 pp. 1958. Penton Publishing Co., Cleveland. (HF5415 M36p Over.)

6586 The Economics of Research and New Product Planning. You can take some of the gamble out of R & D bets with a bit of realistic market analysis and a careful budget estimate. ***Russ Eggers.*** *Product Engineering*, v. 30, no. 10, Mar. 9, 1959, p. 42-43.

6587* Profits in Solar Energy. The major profits in solar-energy equipment and materials, as far as the next few decades are concerned, will be in house heating and cooling equipment. Profits for the converters of energy, that is, the public utilities, in the generation of electricity from solar energy are decades away in the United States. ***George O. G. Löf.*** *Research Management*, v. 1, no. 4, Winter 1958, p. 235-250.

6588* Make-Or-Buy Decisions. There are two broad categories of make-or-buy decisions: (1) whether to add to the existing staff when faced with increased executive functions or to obtain help from an outside organization and (2) whether to acquire equipment, space, etc., or to rent it. ***Maurice Nelles.*** *Research Management*, v. 1, no. 4, Winter 1958, p. 251-259.

See also: **6674** (fuel cells—economics); **6698** (Rand publications in economics); **6941** (nuclear fuels); **7189** (solar energy in Britain).

FLUID MECHANICS

6589 Calculation of Transients in a Cross-Flow Heat Exchanger. Shows how transient temperatures may be calculated by numerical methods. Digital computer programming is considered. A gas-turbine regenerator is used as an example. In particular, methods are developed which are useful when the flow rates vary, as in the starting transient. ***G. M. Dusinberre.*** *ASME, Transactions, Series C, Journal of Heat Transfer*, v. 81, no. 1, Feb. 1959, p. 61-67.

6590* Solutions of Magnetic Gas-Dynamic Equations for Zero Temperature Gradient. (*In Russian.*) O resheniiakh uravneniĭ magnitnoĭ gazodinamiki pri nulevom gradiente temperatury. ***V. P. Korobeinikov and E. V. Riazanov.*** *Akademiia Nauk SSSR, Doklady*, v. 124, no. 1, Jan. 1, 1959, p. 51-52.

6591* The Stability of the Equilibrium of a Solid Having Some Cavities Filled With a Liquid. Proves that Lagrange's theorem is true for a solid body filled with a liquid. (*In Russian.*) Ob ustoĭchivosti ravnovesiya tverdogo tela, imeyuschchego polorti, napolnennye zhidnost'yu. ***V. V. Rumiantsev.*** *Akademiia Nauk SSSR, Doklady*, v. 124, no. 2, Jan. 11, 1959, p. 291-294.

6592* A Variational Principle of Hydromechanics. The part played in variational principles of hydromechanics by a certain group of infinitesimal transformations of the fields of density and velocity. ***S. Drobot and A. Rybarski.*** *Archive for Rational Mechanics and Analysis*, v. 2, no. 5, Feb. 4, 1959, p. 393-410.

6593* Design of Cooler Condensers for Gas-Vapour Mixtures. Graphical method for design of cooler condensers by Mizushina and Kotoo is extended to general gas-vapor systems including air-water having high vapor concentrations. Two examples of air-water system and one example of air-benzene system are solved by this method. Shows that there are good agreement between the results of this method and those of more rigorous ones. ***T. Mizushina, N. Hashimoto, and M. Nakajima.*** *Chemical Engineering Science*, v. 9, no. 4, Feb. 1959, p. 195-204.

6594* Gas-Liquid Flow in Horizontal Pipes. An investigation of the flow of air-water and air-oil mixtures in horizontal smooth pipes with inner diameters ranging from 24 mm. to 140 mm., and rough pipes with an inner diameter of 50 mm. Diagrams are given from which the flow patterns for these mixtures can be predicted. ***C. J. Hoogendoorn.*** *Chemical Engineering Science*, v. 9, no. 4, Feb. 1959, p. 205-217 + 1 plate.

6595* Mass-Transfer From Single Solid Spheres. II. A theoretical analysis of the problem of free convection is shown for Schmidt numbers exceeding 100. ***F. H. Garner and R. B. Keey.*** *Chemical Engineering Science*, v. 9, no. 4, Feb. 1959, p. 218-224 + 1 plate.

6596* On the Action of Surface Active Agents on Mass Transfer in Liquid-Liquid Extraction. The effect of sodium hexadecanyl sulphate and sodium undecanyl sulphate on the rate of mass transfer, droplet oscillation and terminal velocity has been studied during extraction of *o*-nitrophenol and I from aqueous solutions by single drops of CCl. ***G. Boye-Christensen and S. G. Terjesen.*** *Chemical Engineering Science*, v. 9, no. 4, Feb. 1959, p. 225-241.

6597* On the Rate of Mass Transfer From a Gas to a Moving Liquid Film. A theoretical expression is derived for the rate of mass transfer of a substance from the gas phase to a liquid film, in which it is highly soluble, flowing down a vertical surface. It is assumed that the gas phase is in laminar motion. The problem is solved for both the special case of dilute gaseous mixtures, and the more general case of high rates of mass transfer. ***A. Acrivos.*** *Chemical Engineering Science*, v. 9, no. 4, Feb. 1959, p. 242-249.

6598* Vortices. Continuation of a previous study of the vortices produced by the steady flow of water in a tank provided at its lower part with a thin wall aperture. Central vortex, external vortex. The vector-vortex flows through various sections of the central vortex. (*In French.*) Hydraulique. ***Charles Camichel.*** *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*, v. 248, no. 3, Jan. 19, 1959, p. 331-336 + 2 plates.

6599* Beechwood Kaplan Turbines. Hydraulic and Mechanical Features. ***W. S. McIlquham and L. M. Boyd.*** *Engineering Journal*, v. 42, Feb. 1959, p. 56 + 6 pages.

6600 The Continuous and Accurate Proportioning of Liquids Under Variable Flow Conditions With Particular Reference to a New Method. Description of a flotation tank method which was first tried as a means of dosing the drinking water of cattle with phosphate solution. ***W. J. Walker.*** *Institution of Chemical Engineers, Transactions*, v. 37, no. 1, 1959, p. 9-13.

6601 The Prediction of Power Consumption in the Agitation of Non-Newtonian Fluids. The shear rate around an agitator operating in a Bingham fluid is independent of the type of agitator, its size or the relative size of the vessel in which it operates within the limits specified. The results, which may be applied to the majority of non-Newtonian fluids handled in the process industries, make the prediction of agitation power very simple. ***P. H. Calderbank and M. B. Moo-Young.*** *Institution of Chemical Engineers, Transactions*, v. 37, no. 1, 1959, p. 26-33.

6602 Flow Patterns in the Hydraulic Cyclone and Their Interpretation in Terms of Performance. Dye injections into the fluid flowing in hydraulic cyclones have illustrated known features and have added to detailed knowledge of flow patterns. The results are described and the implications on theoretical correlation of efficiency are discussed. Such a correlation can never be precise owing to uncertainties in the path followed by an individual particle. ***D. Bradley and D. J. Pulling.*** *Institution of Chemical Engineers, Transactions*, v. 37, no. 1, 1959, p. 34-45.

6603* Particle Motions in Sheared Suspensions. VIII. Singlets and Doublets of Fluid Spheres. ***W. Bartok and S. G. Mason.*** *Journal of Colloid Science*, v. 14, no. 1, Feb. 1959, p. 13-26.

6604 New Meters Measure Big Volumes Fast. Turbine-type meters handle as much as 20,000 bbl. an hour with remarkable accuracy. Latest is Rockwell's 16-in. meter which measures crude or products of varying viscosity at rates up to 15,000 bbl. an hour. *Oil and Gas Journal*, v. 57, no. 14, Mar. 30, 1959, p. 100-101.

6605 Statistical-Mechanical Theory of Transport in Fluids. A statistical-mechanical theory of transport processes in fluids of g components is presented on the assumption that the macroscopic state of the system can be described by one velocity, one temperature, and g mass-density fields. **Hazime Mori.** *Physical Review*, v. 112, ser. 2, no. 6, Dec. 15, 1958, p. 1829-1842.

6606* The Steady Flow of Viscous Fluid at Low Reynolds Numbers Passing Obliquely Through a Plane Grid Made of Equal Parallel Circular Cylinders. The flow is discussed on the basis of Oseen's equations of motion. ***Kō Tamada and Hiroomi Fujikawa.*** *Physical Society of Japan, Journal*, v. 14, Feb. 1959, p. 202-216.

6607* On Establishing a Poiseille Flow. Assuming that the velocity distribution on approach to the parabolic has a given form, ordinary differential equations were obtained, the

solution of which permits studying the stream in the vicinity of a Poiseille flow. The results obtained from the Novier-Stokes and the Prandtl equations are compared. With sufficiently high Reynolds numbers these solutions practically coincide. (*In Ukrainian.*) Pro vstanovlennia technii puazeylia. ***M. M. Nazarchuk, and N. I. Polsky.*** *Prykladna Mekhanika*, v. 4, no. 4, 1958, p. 442-446.

6608* Progressive and Rotary Impact of a Plate During Flow With Streamline Separation. The coefficients of the added masses of the sheet, $-\mu_{22}$, $-\mu_{32}$ are calculated for the progressive impact, and coefficients μ_{23}, μ_{33} for the rotary impact. The coefficients μ_{22}, μ_{33} diminish equally with an increase in the angle of attack. (*In Ukrainian.*) Postupal'niĭ i obertal'niĭ udar plastini pri obtikanni z vidrivom strumeniv. ***S. I. Parkhomovsky.*** *Prykladna Mekhanika*, v. 4, no. 4, 1958, p. 447-452.

6609* Comparison of Magnetic and Area Flowmeters. Experience with area type meters, used to measure sulphite furnish to newsprint machines, is reviewed. Calibration test procedure is outlined and the results are presented graphically. A comparision is made between results obtained with an area type and a magnetic type stock meter. ***M. Krayewski and G. L. Cooper.*** *Pulp and Paper Magazine of Canada, (Convention Issue)*, v. 60, 1959, p. 236-240.

6610 Flow Through Capillary Tubing With Eccentric Annular Sections. Gas flow through capillaries obstructed by wire inserts was investigated for ratios of core to capillary diameters (B/A's) of 0.08 to 0.9. For a given core-capillary combination, laminar and turbulent as well as an intermediate region are well defined. Deviations from Poiseuille flow for the range of B/A's are presented in a working curve, which will give flow rates for laminar flow correct to from 5 to 10%. ***C. H. Bachman and H. G. Hottenrott.*** *Review of Scientific Instruments*, v. 30, Feb. 1959, p. 126-131.

See also: **6250** (mixture viscosity estimation).

FOOD TECHNOLOGY

6611* Comparison of Flavor Evaluation Methods for Frozen Citrus Concentrate. Compares three taste test techniques for determining the panel's preference among seven samples of frozen orange juice concentrate. ***Mardell D. Tompkins and George B. Pratt.*** *Food Technology*, v. 13, Mar. 1959, p. 149-152.

6612* Storage Rot Susceptibility of Potato Tubers Exposed to Minimum Sprout Inhibiting Levels of Ionizing Radiation. ***D. T. Duncan, W. J. Hooker, and Fred Heiligman.*** *Food Technology*, v. 13, Mar. 1959, p. 159-164.

6613* An Appraisal of New Processing Methods for Military Foods. Discusses canning, refrigeration, antibiotics, dehydration, dehydro-canning and irradiation treatment. ***L. E. Clifcorn.*** *Food Technology*, v. 13, Mar. 1959, p. 176-179.

6614 Flavor Evaluation of Potatoes Grown in Soils Treated With Pentachloronitrobenzene. Flavor evaluation tests on pentachloronitrobenzene-treated potatoes showed statistically significant flavor changes for six of 19 treatment amounts. Potatoes grown in fine sandy loam had a slight tendency toward greater flavor changes than those grown in silt loam and land having a high content of organic matter. Variance analyses showed that pentachloronitrobenzene did not alter the flavor of potatoes grown in treated soil to the extent that consumer acceptance could be affected adversely. Taste panels of untrained individuals were apt to show wide ranges of acuity in detecting flavor changes. ***Peggy Crooke Fry.*** *Journal of Agricultural and Food Chemistry*, v. 7, Mar. 1959, p. 201-203.

FUELS AND COMBUSTION

6615 Recent Advances in Gaseous Detonation. Reviews recent work in gaseous detonation, providing 101 references. ***R. A. Gross and A. K. Oppenheim.*** *ARS Journal*, v. 29, Mar. 1959, p. 173-179.

6616 Isothermal Compressibility of Liquid Oxygen and RP-1. Computation of the isothermal compressibility for these substances using different methods of approach. The accuracy of the calculated result is on the order of the experimentally derived result. ***George T. Y. Chao.*** *ARS Journal*, v. 29, Mar. 1959, p. 199-203.

6617* Combustion in Liquid-Fuel Rocket Motors. A simplified picture of the processes occurring in liquid bipropellant rocket motors. Droplet vaporization, chemical reaction, and drag between gas and droplet are considered for a one-dimensional model. Quantitative theoretical results are presented for the variation of droplet size, droplet velocity, gas temperature and gas velocity within the chamber. ***D. B. Spalding.*** *Aeronautical Quarterly*, v. 10, pt. 1, Feb. 1959, p. 1-27.

6618* Measurement of Gunpowder Burning Rate in a Detonation Wave. The burning rate of HB power $\sim$ 200 to 300 m/sec under pressures of 60,000 kg/cm^2. (*In Russian.*) Izmerenie skorosti goreniia porokha v usloviiakh detonatsionnoĭ volny. ***A. Ia. Apin and L. G. Bolkhovitinov.*** *Akademiia Nauk SSSR, Doklady*, v. 124, no. 2, Jan. 11, 1959, p. 338-339.

6619* Further Studies on Weathering of Coal. An attempt to correlate the intensity of color with the rank of coals. Makes a comparative study of the suitability of different parameters for the assessment of the degree of deterioration of the coke strength. ***J. Bandopadhyay, et al.*** *Coke and Gas*, v. 21, Mar. 1959, p. 99-104.

6620* Some Problems of the French Compressed Fuel Industry. ***John Grindrod.*** *Coke and Gas*, v. 21, Mar. 1959, p. 113 + 1 page.

6621* Investigations on Coal Minerals and Coal and Fuel-Oil Slags. Recent developments and results of experiments carried out by Steinkohlenbergbauverein, Essen, in the field of deposit formation and boiler availability. ***Wilhelm Gumz.*** *Combustion*, v. 30, no. 8, Feb. 1959, p. 51-55.

6622* Heat From Incineration—Available Quantities and Utilization. The increasing use of incinerators as a means of disposing of refuse or waste materials, combined with increasingly high fuel and power costs, poses the question as to how much heat is available from such a furnace, and can it be utilized advantageously. ***H. G. Meissner.*** *Combustion*, v. 30, no. 8, Feb. 1959, p. 57-63.

6623* Methods and Trends in Automatic Combustion Control. Automatic combustion control is defined, and examples are given of basic control layouts for oil- and gas-fired boilers, with some methods used in combination fuel firing. Further examples include controls for a large-capacity unit and simplified control systems for package boilers. Components common to these systems are reviewed. ***K. D. Sheldrick.*** *Engineering Journal*, v. 42, Feb. 1959, p. 62 + 8 pages.

6624 Fuel in Steelworks. Balanced use in production of alloy steels and forgings. ***O. Hirston.*** *Iron & Steel*, v. 32, no. 3, Mar. 1959, p. 89-95.

6625* Partial Dewaxing of Diesel Fuel by Carbamide Water Solution. Two variants of deep dewaxing of a portion of the fuel with subsequent mixing of the dewaxed and underwaxed portions. Deep dewaxing of the heavy tail fraction provides high yields of dewaxed diesel fuel. (*In Russian.*) Partsial'naia deparafinizatsiia dizel'nogo topliva vodnym rastvorom karbamida. ***B. V. Klimenok and E. T. Ignatov.*** *Izvestiia Vysshikh Uchebnykh Zavedenil, Fizika*, 1959, no. 1, p. 63-68.

6626 The Ignition of Combustible Mixtures by Hot Gases. Ignition of cold fuel-air mixtures by hot neutral gases, such as N or CO_2; and the ignition of cold fuel by hot air. ***H. G. Wolfhard.*** *Jet Propulsion*, v. 28, Dec. 1958, p. 798-804.

6627* Improvement of the Production of Open-Hearth Furnaces Fired With Lean Gas by the Injection of Compressed Gases Through the Burners. Injections increase the oxidizing power of the flame consumption of iron. Judicious choice of the fluid utilized and of the injection conditions productivity, the costs of fabrication. (*In French.*) Amélioration de la production des fours Martin chauffés au gaz pauvre par

l'injection de fluides comprimés dans leurs bruleurs à gaz. ***L. Septier, S. Terrat, R. Kissel, and J. Moreau.*** *Revue de Métallurgie*, v. 56, Feb. 1959, p. 179-202.

6628* Lignite Fuels New Traveling Grate Installation. Raw materials readily available for N. Central Lightweight Aggregate Co. ***Elwood Meschter.*** *Rock Products*, v. 62, Mar. 1959, p. 88-91.

6629* Here's What's Needed to Supply Clean Fuel for Turbine Transports. The problem breaks down into three parts: How clean must the fuel be? How is cleanliness measured? How can fuel cleanliness be controlled? ***G. T. Coker and R. G. Davis.*** *SAE Journal*, v. 67, Mar. 1959, p. 50-51.

6630 Developments in Cyclone Firing and Pulverized-Fuel Firing of Low Volatile Coals. Reviews developments in cyclone firing since the 1957 Conference. ***W. G. Marskell.*** Paper from "Second Conference on Pulverized Fuel, Proceedings at the Conference 27th and 28th November 1957", The Institute of Fuel, London. p. C1-C7. (TP238 C76pr.)

6631* Complete Gasification. The final motif in the fuel pattern. ***F. J. Dent.*** *Times Review of Industry*, v. 13, Feb. 1959, p. 27 + 2 pages.

6632* Shale-Oil Activities. Industry studies possibilities of atomic energy to reduce costs of mining and retorting. Research and pilot-plant work lags. Eastern Hemisphere commercial applications expand. ***Russell J. Cameron and Robert E. Gustafson.*** *World Petroleum*, v. 30, Mar. 1959, p. 66 + 5 pages.

See also: **6227** (refractories for oil-fired furnaces); **6257** (carbonization of recent coals); **6577** (Britain's fuel needs); **6681** (combustion chamber pressure loss); **6684** (wider fuel specifications for engineers); **7042** (fine coal cleaning); **7044** (coal flotation).

GEOLOGY, GEOPHYSICS, MINERALOGY, AND MINING ENGINEERING

6633* The Settling of Rhodochrosite From Chloride, Sulphate and Bicarbonate Manganese Solutions. Experimental study of physical-chemical settling conditions of $MnCO_3$ from chloride and sulfate solutions of various concentrations in interaction with $NaHCO_3$ solutions, followed by an investigation of deposits obtained under defined equilibrium conditions. Study of the crystallization process of $MnCO_3$ from Mn bicarbonate solutions with an elimination of various amounts of carbonic acid from these solutions. (*In Russian.*) Osazhdenie rodokhrozita iz khloridnykh, sul'fatnykh i bikarbonatnykh rastvorov margantsa. ***L. P. Listova.*** *Akademiia Nauk SSSR, Doklady*, v. 124, no. 1, Jan. 1, 1959, p. 183-186.

6634* Aerial Distribution of Earth Ejected by Underground Explosions. The picture of the ejection of earth is established. An empirical formula is derived for the average amount of earth falling out per surface unit at a given distance from the center of the explosion. (*In Russian.*) Raspredelenie na mestnosti grunta, vybrasyvaemogo pri podzemnykh vzryvakh. ***V. N. Sakharov, V. I. Kolesnikov-Svinarev, V. A. Nazarenko, and E. I. Zabidarov.*** *Akademiia Nauk SSSR, Doklady*, v. 124, no. 2, Jan. 11, 1959, p. 314-317.

6635* Ruby Spinel in Marbles of Pereval Deposits and Its Secondary Alterations. (*In Russian.*) Krasnaia shpinel' v mramorakh mestorozhdeniia pereval i ee vtorichnye izmeneniia. ***M. I. Zheru.*** *Akademiia Nauk SSSR, Izvestiia, Seriia Geologicheskaia*, 1959, no. 2, Feb., p. 107-114.

6636* Mesometeorology—The Link Between Macroscale Atmospheric Motions and Local Weather. Its role in local weather forecasting. ***Morris Tepper.*** *American Meteorological Society, Bulletin*, v. 40, Feb. 1959, p. 56-72.

6637* Hardness of Synthetic and Natural Micas. The hardness of synthetic fluorphlogopite and of two natural muscovites, as measured on (001) by the Knoop indentation method, is definitely anisotropic. The lesser hardness of natural micas (excluding margarite) in comparison with the synthetic fluormicas is postulated to result, at least in part, from the greater polarizability of (OH) ion than of F ion. ***F. Donald Bloss, Ebraham Shekarchi, and H. R. Shell.*** *American Mineralogist*, v. 44, nos. 1-2, Jan.-Feb. 1959, p. 33-48.

6638 The Anelasticity of Natural and Synthetic Quartz at Low Temperatures. Certain imperfections in alpha-quartz are found to introduce anelastic absorption at low temperatures in crystal resonators. The results of acoustic absorption measurements on a number of selected samples of synthetic quartz resonators suggest that, whereas the 50 K absorption is attributable to excess oxygen, the 100 K defect involves Al which is present substitutionally in the crystal structure. ***J. C. King.*** *Bell System Technical Journal*, v. 38, no. 2, Mar. 1959, p. 573-602.

6639 Flash Roasting (of Zinc Concentrates) at the UST-Kamenogorsk Combine. Details on the conversion of a multiple-hearth furnace for zinc concentrates into a flash roaster. Optimum operating conditions. Temperature measurements in bed. Best ways of shutting down a flash roaster. Comparison of operating variables. Grinding of unroasted concentrate; screen analysis data on concentrate and roast. General promise. ***V. E. Lunev and V. I. Chuprikov.*** *Henry Brutcher Translation No.* 4379, 11 pp. (From *Tsvetnye Metally*, v. 30, no. 2, 1957, p. 32-36.) Henry Brutcher, Altadena, Calif.

6640* The H-Bomb—Another Gambit for Athabska Oil Sands. Federal Cabinet has yet to decide whether gains possible in Richfield Oil's proposal for a test explosion warrant the political and health risks involved. *Canadian Chemical Processing*, v. 43, Mar. 1959, p. 63 + 3 pages.

6641 Cosmic Electrodynamics. Electromagnetic phenomena on the sun, magnetic storms and aurorae. Stellar and interstellar fields, the acceleration of cosmic ray particles and electrodynamical problems of the ionosphere. ***J. W. Dungey.*** 183 pp. 1958. Cambridge University Press, London. (QC809.E55 D91c)

6642* The Earth and Its Environment. Review of the IGY enterprises. ***Sydney Chapman.*** *I.R.E. Proceedings*, v. 47, Feb. 1959, p. 137-141.

6643* Yield-Depression Curves of Discharging Wells, With Particular Reference to Chalk Wells, and Their Relationship to Variations in Transmissibility. Development and interpretation of these curves, and the relationship between these curves and variations in values of transmissibility determined by analysis of nonsteady state data obtained during pumping tests on these wells. ***J. Ineson.*** *Institute of Water Engineers, Journal*, v. 13, no. 2, Mar. 1959, p. 119-163.

6644* About Structural Classifications of Oil and Gas Fields. Division into two types of fields in horizontal and folded regions. Each type is subdivided into four groups, depending upon the structural form and gives peculiarities of the oil-gas-bearing structures. (*In Russian.*) O strukturnykh klassifikatsiakh neftianykh i gazovykh mestorozhdenii. ***V. S. Kliucharev.*** *Izvestiia Vysshikh Uchebnykh Zavedenii, Fizika*, 1959, no. 1, p. 3-8.

6645* Colorado Uranium Ores. Sampling of the above. *Mining Magazine*, v. 100, no. 2, Feb. 1959, p. 90.

6646* Will Deep Sea Bottom Make Tomorrow's Manganese Mines? Vast tonnages of Mn nodules containing Co and Fe await harvesting by deep sea dredging. Separation metallurgy looks simple. ***John L. Mero.*** *Mining World*, v. 21, no. 3, Mar. 1959, p. 39.

6647* How Hecla Longwalls U_3O_8 Stopes. Flat lying relatively hard ore, soft and incompetent walls, a few low grade zones for pillars, and high grade ore called for a unique mining system. Longwall retreat with collapsible steel props proved the solution. *Mining World*, v. 21, no. 3, Mar. 1959, p. 44-47.

6648 Miscible-Phase Floods May Precipitate Asphalt. Conditions under which precipitation may be encountered. ***Robert B. Bossler and Paul B. Crawford.*** *Oil and Gas Journal*, v. 57, no. 9, Feb. 23, 1959, p. 137 + 5 pages.

6649 Viscous Crudes Respond to Water Flooding. Viscous crudes are being recovered efficiently in some Kansas water floods in spite of unfavorable mobility ratios. *Oil and Gas Journal*, v. 57, no. 14, Mar. 30, 1959, p. 189 + 3 pages.

6650* Oilfield Development. II. Some Geological Aspects. Methods of determining basic geological data are outlined, together with techniques for correlating this data and the pattern of development drilling to assess the field's potential. ***C. A. Fothergill.*** *Petroleum*, v. 22, Mar. 1959, p. 107-110.

6651 Developments in Natural Gas Reservoir Engineering. Evaluation of recent developments in natural gas reservoir engineering research and problems to be solved. ***M. R. Tek.*** *Petroleum Engineer*, v. 31, Mar. 1959, p. B47-B49.

6652* Recent Developments in the Study of Interstellar and Interplanetary Media. A brief review of recent studies in this field. (*In Russian.*) Novoe v izuchenii mezhzvezdnoĭ i mezhplanetnoĭ sredy. ***V. G. Fesenkov.*** *Priroda*, v. 48, no. 2, Feb. 1959, p. 4-7.

6653* Resistivity Survey—A Good Bet in Preliminary Searches for Deposits. Geophysical technique provides a quick, economical means of finding and mapping deposits of sand, gravel, and limestone. ***Robert B. Johnson.*** *Rock Products*, v. 62, Mar. 1959, p. 82-85.

6654 American Oceanography Survey and Proposals for Ten-Year Program Made by NAS-NRC Committee. *Science*, v. 129, Feb. 27, 1959, p. 550-557.

6655* Studies on the Hydrated Iron Oxides. IV. Iron Oxide Minerals Altered From Magnetite by Weathering. The alteration process of natural oxidation of magnetite from the capping of magnetite deposits at Takanokura Mine, Fukushima Prefecture may be induced. In this report, the mineralogical properties of some minerals altered from magnetite, namely, hydrous magnetite, maghemite and goethite, are also described. ***Matsuo Nambu.*** *Tôhoku University, Science Reports of the Research Institutes, Ser. A. Physics, Chemistry, Metallurgy*, v. 10, no. 6, Dec. 1958, p. 453-458.

6656 Contributions to Stratospheric Meteorology. Discussions of eight interrelated studies of stratospheric meteorology. ***Peter Antanaitis, et al.*** *U. S. Air Force, Cambridge Research Center, GRD Research Notes, No.* 1, Aug. 1958, 134 pp. (QC806 Un3.23g Contin.)

6657* Subterranean Water Collector. A system of underground water collection in Switzerland. ***H. Fehlmann and J. H. Fehlmann.*** *Water & Sewage Works*, v. 106, Feb. 1959, p. 60-64.

6658* Unmanned Ocean Weather Stations. Equipment developed by the National Bureau of Standards' Electronic Instrumentation Laboratory will automatically record and broadcast weather information for months on end, with no human intervention, from remote areas of the world's oceans. ***B. W. Powell.*** *World Science Review*, 1959, Mar., p. 9-12.

See also: **6246** (horizontal movement of water in soil); **6576** (mineral dressing economics); **6583** (U. S. 1958 mineral output); **7110** (crystalline conversion in geology).

GRAPHIC ARTS

6659* Aluminum in the Printing Industry. Deals with aluminum as a print carrier (normal offset printing and the associated problems, small offset printing with the related transfer processes with special attention to the dry printing process known as xerography), and the use of aluminum in composing (composing and justifying, relief printing, etc.) (*In German.*) Aluminium in der graphischen Industrie. ***W. Oberst.*** *Aluminium (Dusseldorf)*, v. 35, Mar. 1959, p. 148-155.

6660 Optics and Photography in the Flying Spot Store. Describes and discusses some of the optical and photographic problems to be considered in the construction of the above. ***M. B. Purvis, G. V. Deverall, and D. R. Herriott.*** *Bell System Technical Journal*, v. 38, no. 2, Mar. 1959, p. 403-424.

6661* Canada and the Airborne Camera. A historical account. ***W. C. H. Pearce.*** *Canadian Aeronautical Journal*, v. 5, no. 2, Feb. 1959, p. 55-66.

6662* Ultrasonic Image Camera. The device equipped with a piezoelectric tube, not unlike a photoelectric television camera, will permit visual studies to be made of the internal structure of objects which are transparent to ultrasonic waves and are immersed in a suitable medium. It has applications to the nondestructive testing of materials and engineering components and to medical diagnosis. *Engineer*, v. 207, Feb. 27, 1959, p. 348-350.

6663 High-Speed Camera Delivers Three-Way Advantage. Cites safety in recording action, leisure in studying the record, and ease of communicating technical data. *Industrial Photography*, v. 8, Mar. 1959, p. 42-43.

6664* Increased Depth of Field for Motion-Picture Photography. An accurately calibrated camera aperture which pivots on its vertical center is proposed as one means of increasing the depth of field across the picture area. ***Sidney Zipser.*** *Society of Motion Picture and Television Engineers, Journal*, v. 68, Feb. 1959, p. 74-76.

6665* Photography of Very Early States of Nuclear Explosions. A 10-ft. focal length Newtonian telescope was used to give a large image with the camera at approximately 7 miles from the explosion with a 1-μ sec exposure. ***Harold E. Edgerton.*** *Society of Motion Picture and Television Engineers, Journal*, v. 68, Feb. 1959, p. 77-79.

See also: **6214** (photographic patterns in glass); **6411** (chemistry of color photography); **6464** (spectrophotometric evaluation of colorants); **7141** (photosensitive coatings).

HEAT POWER

6666 Performance Calculations for Hybrid Nuclear-Chemical Rocket Propulsion Systems. ***Leon Green, Jr. and James M. Carter.*** *ARS Journal*, v. 29, Mar. 1959, p. 180-186.

6667 Transient Heat Transfer to Laminar Forced Convection in the Thermal Entrance Region of Flat Ducts. Analyzes the above (parallel plate channel) whose bounding surfaces are subjected to an arbitrary time variation of temperature or of heat flux. Heat-transfer results are presented as simple analytical expressions. ***R. Siegel and E. M. Sparrow.*** *ASME, Transactions, Series C, Journal of Heat Transfer*, v. 81, no. 1, Feb. 1959, p. 29-36.

6668 Heat Transfer to a Boiling Liquid—Mechanism and Correlations. Various heat-transfer mechanisms are analyzed in the light of recent experiments. Evidence is presented in favor of a vapor-liquid exchange mechanism. A "Reynold's analogy" for nucleate boiling is presented. A procedure is given for calculating the superheat at which the liquid bulk velocity ceases to contribute to the heat flux. An expression for the growth af a vapor bubble in a highly superheated liquid is deduced. Shows that one correlation yields the heat flux for different liquids varying from water to Hg, without necessitating any change in constant or exponent of the correlation. ***Kurt Engelberg-Forster and R. Greif.*** *ASME, Transactions, Series C, Journal of Heat Transfer*, v. 81, no. 1, Feb. 1959, p. 43-53.

6669 Investigation of Heat Transfer, Flow, and Heat Exchangers as Related to Turbine Cooling. Résumé of the primary unclassified investigations in the field of turbine cooling during the period, including general cooling studies, air and liquid transfer studies, fluid flow studies, and related heat-exchanger investigations. ***H. H. Ellerbrock, Jr. and John N. B. Livingood.*** *ASME, Transactions, Series C, Journal of Heat Transfer*, v. 81, no. 1, Feb. 1959, p. 79-85.

6670 Heat Transfer and Friction for Fluids Flowing Over Surfaces at High Temperatures and High Velocities. Discusses the pertinent literature appearing in the period 1946 to 1956 on the transfer of heat by forced convection between surfaces and fluids for Mach numbers up to 8 and temperature differences of the order of 2500 F. Tubes of various cross-sectional shapes, flat plates, and nozzles are discussed. ***R. G.***

Deissler and A. L. Loeffler, Jr. *ASME, Transactions, Series C, Journal of Heat Transfer*, v. 81, no. 1, Feb. 1959, p. 89-91.

6671 Prophecy for Propulsion—One Man's Guess. A single-barrel, liquid-propellant rocket engine of a million pounds of thrust can be operational by 1965. ***T. F. Dixon.*** *Aero/Space Engineering*, v. 18, Feb. 1959, p. 35-39.

6672* Heat Recovery From Diesel Engines. Determining heat available for space heating. ***W. E. Bell.*** *Air Conditioning, Heating, and Ventilating*, v. 56, Mar. 1959, p. 57-60.

6673* 1959 . . . U. S. Aircraft Engines. Reciprocating Type. Tabulated specifications. *Aircraft and Missiles Manufacturing*, v. 2, Mar. 1959, p. 68-69.

6674* Fuel Cells: Friends or Foes? New devices produce electrical energy directly from gas at high efficiency rates; could revolutionize our energy concepts. Fuel cells, by definition, are primary electrochemical devices that oxidize a fuel and convert a substantial portion of the heat of oxidation directly to electrical energy. In a true fuel cell, fuel is supplied continuously to the negative electrode and the oxidizing agent is supplied continuously to the positive electrode, with the device thus operating continuously and producing a steady and constant output of electrical energy. ***Dean Hale.*** *American Gas Journal*, v. 186, Feb. 1959, p. 20-21.

6675 U. S. Reciprocating Engines. Tabulated specifications. *Aviation Week*, v. 70, Mar. 9, 1959, p. 198.

6676 U. S. Gas Turbine Engines. Tabulated specifications. *Aviation Week*, v. 70, Mar. 9, 1959, p. 201.

6677 GE Official Details Nuclear Plane Need. Letters and text outlining the importance of accelerating the U. S. nuclear aircraft program, the feasibility of such a plane and its potential as a weapon system to President Eisenhower and Rep. Price. ***John W. Darley, Jr.*** *Aviation Week*, v. 70, Mar. 16, 1959, p. 67 + 11 pages.

6678 Matching the Boiler Feed Pump to the Job. ***R. A. Miller.*** *Blast Furnace and Steel Plant*, v. 47, Mar. 1959, p. 310 + 5 pages.

6679* Considerations on the Design of Graphite Heat Exchangers. Shows that when a new material is used for an existing application, it may be preferable to base the design on the properties of the material alone, without reference to existing construction or prior art. A heat exchanger which was developed on these principles, the Polybloc, is described, and its various features are discussed. ***A. Hilliard.*** *British Chemical Engineering*, v. 4, Mar. 1959, p. 138-143.

6680* Self-Regulating Alternator. Description of a new alternator which uses a completely static excitation system and is claimed to have superior voltage response characteristics. *Coke and Gas*, v. 21, Mar. 1959, p. 109-110.

6681 Combustion Chamber Pressure Loss. A simple method for calculating the ratio between the total pressure at the throat, and the static pressure at the injector plate. ***S. L. Bragg and S. P. Q. Byworth.*** *Jet Propulsion*, v. 28, Dec. 1958, p. 829.

6682* Operating a Fleet of 300 Rollers. Practical experience related to prime movers. *Oil Engine and Gas Turbine*, v. 26, Feb. 1959, p. 384-385.

6683* The Latest Higher-Power Fast-Running Engines. Paxman air-cooled vertical and Vee designs up to 466 b.h.p.: water-cooled pressure-charged Vee 12 and 16 units up to 1,870 b.h.p. *Oil Engine and Gas Turbine*, v. 26, Feb. 1959, p. 386-389.

6684* Engine Design for Wider Fuel Specifications. Appreciation of long-term possibilities. *Oil Engine and Gas Turbine*, v. 26, Feb. 1959, p. 392.

6685* A New Range of Fuel Systems for Industrial Gas Turbines. I. Pressure Jet Burners and Standardized Control Units Available for Dowty Layouts. *Oil Engine and Gas Turbine*, v. 26, Feb. 1959, p. 397-401.

6686* The First 7800 HP Marine Engine Assembled in Cegielski (Poznań) Factory Is About to Begin Its Sea Service. (*In Polish.*) Pierwszy zmontowany w HCP silnik okrętowy 7800 KM rozpocznie wkrótce pracę na morzu. *Przegląd Techniczny*, 1959, no. 6, Feb., p. 20.

6687* Putting Injection Benefits Into Carbureted Engines. Recent Ethyl radioactive tracer tests of fuel distribution indicate that improved fuel and additive distribution through better carburetion can yield many of the benefits of fuel injection. ***D. E. Cooper, R. L. Courtney, and C. A. Hall.*** SAE *Journal*, v. 67, Mar. 1959, p. 55-56.

6688* Choice of Engines for Aircraft. Stages in the choice of an engine, the type of powerplant, the number of engines and choice of a particular engine. The best engine for a particular application can only be arrived at by a lengthy and close collaboration between aircraft and engine designer. The engine itself is considered. In practice, the complete propulsive or lifting system of intake, engine and exhaust must be considered as an entity. ***W. A. Pennington.*** *Shell Aviation News*, 1959, no. 247, Jan., p. 14-19.

See also: **6258** (cyclohexylamine boiler water treatment); **6615** (gaseous detonation); **6617** (combustion in liquid-fuel rocket motors); **6724** (vibration of engine shaft); **6864** (steel for steam turbine rotors).

INFORMATION—PREPARATION AND DISSEMINATION

6689 Application of a Telereference System to Divisional Library Card Catalogs. A Feasibility Analysis. The term "Telereference" refers to a system which would permit a researcher to view catalog cards in a central catalog from a remote location by the use of closed-circuit television and a remotely controlled card manipulator. ***F. R. Bacon, N. C. Churchill, C. J. Lucas, D. K. Maxfield, C. J. Orwant, and R. C. Wilson.*** 91 pp. 1958. Council on Library Resources, Inc., Washington, D. C. (Z716.8 M58.8a Over.)

6690 The Function and Design of the Scientific Message. Messages should be designed to bring the perception of the receiver into close harmony with the perception of the sender so that information can be transmitted from the consciousness of the sender to that of the receiver with a minimum of loss. ***Harry F. Arader.*** *IRE Transactions on Engineering Writing and Speech*, v. EWS-2, no. 1, Jan. 1959, p. 2-5. (TK1 In6.6ew Vis.)

6691 Use Your Reader's Eyes. The author explains that the general functions of illustration are familiarization, explanation, validation, and lending authority. ***P. M. Beatts.*** *IRE Transactions on Engineering Writing and Speech*, v. EWS-2, no. 1, Jan. 1959, p. 6-11. (TK1 In6.6ew Vis.)

6692 Selecting and Writing to the Proper Level. Of prime importance to anyone engaged in written communication is the ability to determine the proper level at which the material should be written—this article tells how this may be accomplished. ***Joseph Racker.*** *IRE Transactions on Engineering Writing and Speech*, v. EWS-2, no. 1, Jan. 1959, p. 16-21. (TK1 In6.6ew Vis.)

6693 Can They *See* What You *Say* When You *Speak*? Proper planning of the type and content of visual aids will go a long way towards orienting the listener and making him much more receptive to your message. ***Edwin W. Still.*** *IRE Transactions on Engineering Writing and Speech*, v. EWS-2, no. 1, Jan. 1959, p. 24-29. (TK1 In6.6ew Vis.)

6694 Administration of Technical Information Groups. ***W. T. Knox.*** *Industrial and Engineering Chemistry*, v. 51, Mar. 1959, pt. I, p. 48A + 11 pages.

6695* Research Methodology for Machine Translation. The RAND methodology is a system for preparing Russian scientific text on punched cards, for producing translations in analyzable form, and for exposing the relationships between

the original and translated versions, semiautomatically, in such a way that translation can be programmed. *MT, Mechanical Translation*, v. 5, no. 1, July 1958, p. 8-15.

6696* A Programming Language for Mechanical Translation. A notational system for use in writing translation routines and related programs is described. The system is specially designed to be convenient for the linguist so that he can do his own programming. ***Victor H. Yngve.*** *MT, Mechanical Translation*, v. 5, no. 1, July 1958, p. 25-41.

6697 Punched Cards. Their Applications to Science and Industry. *Robert S. Casey, James W. Perry, Madeline M. Berry, and Allen Kent, editors.* 2nd Ed. 697 pp. 1958. Reinhold Publishing Corp., New York. (HF5371 C26p2)

6698 Selected List of Unclassified Publications of the Economics Division of the Rand Corporation. *Rand Corporation, Research Memorandum, RM-821-6*, Dec. 15, 1958, 26 pp. (T13 R15.2r Contin.)

6699 Russian Pronunciation. In studying Russian pronunciation, beginners have little inclination to learn the necessary symbols of the International Phonetic Alphabet while they are struggling with the novelty of Cyrillic characters. However, the Russian alphabet can be easily adapted to serve as a means for recording the pronunciation of the language. Such a system is used in this book. ***Dennis Ward.*** 90 pp. 1958. Hafner Publishing Company, New York. (PG2137 W21r)

INSTRUMENTATION

6700 A Modified Vicat Type Apparatus for Measuring the Softening Point of Thermosetting Plastics and Laminates. Essential modification is the use of a metal block enclosing the sample holder which provides a more uniform heat source than on air oven alone. ***G. F. L. Ehlers.*** *ASTM Bulletin*, no. 236, Feb. 1959, p. 54-56.

6701* Instruments Used for Chemical Analysis by Infrared Absorption Methods. Definitions and a summation of the principles of spectrophotometry in the infrared region. Types of instruments in use. (*In French.*) L'instrumentation dans l'analyse chimique par absorption infrarouge. ***F. Gans.*** *Acta Electronica*, v. 3, no. 1, Jan. 1959, p. 43-57.

6702 A Microwave Electron Velocity Spectrograph. An electron-velocity spectrograph is described which can be used to measure the velocity distribution of electrons in a high-density electron beam modulated at microwave frequencies. Using this instrument, it was found that the velocity spread at a quarter of a reduced plasma wavelength is very small under small-signal conditions, in agreement with small-signal, space-charge-wave theory. ***P. B. Wilson and E. L. Ginzton.*** *IRE Transactions on Electron Devices*, v. ED-6 no. 1, Jan. 1959, p. 64-68. (TK1 In6.6ed Vis.)

6703 Automatic Titrimetry: A Simple Apparatus for Recording Full Scale Potentiometric Titrations. Apparatus consists of three essential parts: an injection delivery system, a system indicating pH or e.m.f. change, and a recorder. ***J. Haslam and D. C. M. Squirrell.*** *Journal of Applied Chemistry*, v. 9, pt. 2, Feb. 1959, p. 65-68.

6704 Refractory-Metal Thermocouples Containing Rhenium. The thermoelectric force developed by the following junctions up to 2200 C was measured: Re *vs* W, Re *vs* Mo, Re *vs* W—30Re, and Re *vs* Mo—50Re. The thermoelectric force for W *vs* W—30Re and Mo *vs* Mo—50Re was calculated. The Re *vs* W junction develops about 15 mv at 1000 C and may be usable up to 2600 C. The calculated outputs of W *vs* W—30Re and Mo *vs* Mo—50Re are high; the W *vs* W—30Re output is nearly linear over a wide range in temperature, and the thermocouple should be useful to about 2600 C. All of these couples must be used in vacuum or in neutral or reducing atmospheres. ***Chester T. Sims, Gordon B. Gaines, and Robert I. Jaffee.*** *Review of Scientific Instruments*, v. 30, Feb. 1959, p. 112-115.

6705 Interim Progress Report. Development of a Pulse Preamplifer for Use at 540°F. Amplifier developed and given limited evaluation at chassis temperatures of 600°F for several hours without failure. Gain drift observed to be less than .013%°F including initial aging. ***W. L. Frisby.*** *U. S. Atomic Energy Commission, APEX-447*, June 27, 1958, 96 pp. (UF767 Un3.lap Contin.)

LUBRICATION AND FRICTION

6706* What Determines Engine Oil Consumption? Radioactive tracers were added to diesel engine lubricating oil so that when the oil was burnt in the cylinders the activity would pass into the exhaust gases. By monitoring the activity in the exhaust it was possible to determine the oil consumption. A correlation between oil consumption and engine wear was made. Effect of running conditions on consumption was determined. ***M. Pobereskin, D. N. Sunderman, and E. J. Fithian.*** *Atomic World*, v. 10, Mar. 1959, p. 110-111.

6707* European Cars. II. Engines. Discusses lubrication requirements. Classifications of lubricants; oil drain intervals for city and suburban driving, cold weather or start-and-stop driving, and open highway driving; tables of car manufacturer's motor oil recommendations for foreign cars. Various designs of clutches, manual and automatic transmissions, differentials, brakes, and suspension systems and specifies types of lubricants to use for each. *Lubrication*, v. 45, Feb. 1959, p. 13-36.

6708* Investigation of Factors Affecting High-Temperature Gear Operation. Studies to find lubricants, materials and gear designs that will operate successfully at high temperatures. ***E. E. Shipley.*** *Lubrication Engineering*, v. 15, Mar. 1959, p. 98 + 6 pages.

6709* Determining Wear in Automotive Engines. Piston ring, piston pin, and valve train wear under various operational conditions are discussed. Includes radioactive tracer methods. ***R. L. Pontious.*** *Lubrication Engineering*, v. 15, Mar. 1959, p. 110 + 6 pages.

6710* A Preformed Organic Thickener for Lubricating Grease. Making grease from preformed thickeners and properties of the grease; results of compatability tests. With high concentrations of lithium, silica, or sodium greases, good results were obtained in mechanical-stability tests, cone-and-breaker leakage test at 212 F and 250 F wheel-bearing test. ***J. E. Kline, W. L. Hayne, Jr. and T. P. Traise.*** *NLGI Spokesman*, v. 22, no. 12, Mar. 1959, p. 533-536.

6711* Two Tons of Grease. The design and use of a large-volume bulk-handling system. ***J. W. Waite.*** *NLGI Spokesman*, v. 22, no. 12, Mar. 1959. p. 548-551.

6712* Reduction of the Varieties of Types and Estimation of the Quality of Lubricants Used in the Steel and Mining Industries. Measure of viscosity in lubrication engineering. Classification of lubricating oils. Pure-viscous and structural-viscous lubricants. Quality control: physical and chemical methods as well as functioning tests. Investigation on lubricating oils used in rolling mills. Testing greases for roll neck bearings with high circumferential speeds of the antifriction bodies. (*In German.*) Sortenbeschränkung und Gütebewertung von Schmierstoffen für Hüttenindustrie und Bergbau. ***Georg Heinz Göttner.*** *Stahl und Eisen*, v. 79, no. 3, Feb. 5, 1959, p. 148-156.

6173 Lubricating Properties of Lead-Monoxide-Base Coatings of Various Compositions at Temperatures to 1250°F. Study of PbO-containing dry-film lubricants. Other oxides in the formulations influenced such properties as softening points, adherence to metals, hardness, vitrifying tendencies, or chemical stability. Several coatings protected metals against adhesive wear at test temperatures from 75 to 1250 F. ***Harold E. Sliney.*** *U. S. National Aeronautics and Space Administration, NASA Memorandum* 3-2-59E. Feb. 1959, 22 pp. (TL782 Un3rm Vis.)

MECHANICAL ENGINEERING

6714 False Negative Permanent Strains Observed With Resistance Wire Strain Gages. In connection with a project that involved the determination of the elastic limit of specimens of steel, it was observed that below the yield point the resistance gages often indicated strains upon release of the load that were oppositely directed to the preceding load. Comparison with permanent strains observed with optical gages on the same specimen showed that in this case the negative strain was a false indication of the resistance gage. ***Clarence J. Newton.*** *ASTM Bulletin*, no. 235, Jan. 1959, p. 42-44.

6715 Measurement of Bulk Modulus of Hydraulic Fluids. Ultrasonic velocity apparatus for determining adiabatic bulk modulus at temperatures to 500 F and pressures to 5000 psi is described. Measurements are reported on MIL-H-5606A fluid (petroleum-base) and Oronite high-temperature hydraulic fluids 8515 and 8200 (silicate ester-base). Only minor differences were found among the three fluids, with the silicate ester fluids having slightly higher bulk moduli above 400 F. ***R. L. Peeler and J. Green.*** *ASTM Bulletin*, no. 235, Jan. 1959, p. 51-57.

6716* Effects of Longitudinal Forces on Portal Frame Supporting a Highway Bridge Deck. General solution of frames with prismatic members is presented; the method may be extended to members with variable cross sections. ***Tung Au and Thomas D. Y. Fok.*** *American Concrete Institute, Journal*, v. 30; *ACI Proceedings*, v. 55, no. 8, Feb. 1959, p. 851-865.

6717* Blast Resistance of Reinforced Concrete Beams Influenced by Grade of Steel. A method is presented for the comparison of different grades of steels used as reinforcement in a beam subjected to transient loading. This method is useful for comparing the dynamic load capacity of beams reinforced with varying amounts of different grades of reinforcing steel. It is shown that whether one type of steel is better than another depends primarily on the criterion of failure chosen. ***Warren A. Shaw and J. R. Allgood.*** *American Concrete Institute, Journal*, v. 30; *ACI Proceedings*, v. 55, no. 9, Mar. 1959, p. 935-945.

6718 Introduction to the Theoretical and Experimental Analysis of Stress and Strain. Mathematical method of analysis; introduction to the use of experimental stress-analysis methods; grid methods; brittle-coating methods; mechanical strain gages. ***A. J. Durelli, E. A. Phillips, and C. H. Tsao.*** 498 pp. 1958. McGraw-Hill, New York. (TA405 D93i)

6719* Evaluation of Fluids by Hydraulic Pump Tests. Methods of testing, including pump test method; evaluation of pump test data; advantages and practical use of pump tests. ***William M. Schrey.*** *Lubrication Engineering*, v. 15, Feb. 1959, p. 64-67.

6720 Six Basic Design Rules for Brazed Honeycomb Sandwich. Select materials to withstand brazing conditions; design around narrow tolerances; provide uniform pressure and temperature distribution; plan for effective brazing assembly; vary core density to transmit loads efficiently; consider the sandwich as a material. ***Floyd F. Rechlin.*** *Materials in Design Engineering*, v. 49, Mar. 1959, p. 100-105.

6721 Mechanics of Machinery. Mechanisms and components; kinematics and dynamics of machines. ***C. W. Ham, E. J. Crane, and W. L. Rogers.*** 4th Ed. 509 pp. 1958. McGraw-Hill, New York. (TJ170 H17m4)

6722 A Standardizing Strain Gage for Measurements Requiring Long-Time Stability. New type of unbonded elastic wire strain gage is described. Strains are determined by measuring the changes in electrical resistance of the elastic wire with conventional strain bridges, but long-time stability is achieved by referring all strain measurements to a built-in Invar length standard. ***G. E. Monfore.*** *Portland Ceemnt Association, Research Department Bulletin* 96, Nov. 1958, 8 pp. (TP883 P83b Vis.)

6723* Shrink-Fit Flexure Stresses in a Thin Plate. Shrink-fit flexure stresses arise on pressing coned washers into openings of a multilinked plate. The problem of determining these stresses is reduced to the first fundamental problem of the plane theory of elasticity for the domain which is occupied by the connected bodies. (*In Ukrainian.*) Napruzhennia zginu v tonkiĭ pliti pri z'ednanniakh z natiagom. ***D. V. Vainberg and A. G. Ugodchikov.*** *Prykladna Mekhanika*, v. 4, no. 4, 1958, p. 396-400.

6724* Vibrations of an Internal Combustion Engine Shaft, Taking Into Account Variability of the Moment of Inertia. The stability of motion of the system was investigated, and the forced vibrations were taken into consideration. With the order of disturbing forces having a practical significance, the variability of the moment of inertia is not a factor lowering the amplitude of resonance vibrations. (*In Ukrainian.*) Pro kolivannia vala dviguna vnutrishn'ogo zgoriannia z urakhuvanniam zminnosti momentu inertsii. ***G. I. Koliadin.*** *Prykladna Mekhanika*, v. 4, no. 4, 1958, p. 411-420.

6725* On the Stressed State of Cylinder of Finite Length. Analysis of stresses in a short thick-walled elastic cylinder in the case when normal loads are applied only to the lateral surfaces of the cylinder and may cause strains unsymmetrical in respect to the cylinder axis. Results are given of a computation of a cylinder with cosinoidal loads acting on the lateral surfaces. A calculation for a ring subjected to similar loads on its profile is given for comparison. The maximum strains in the cylinder prove to be only 2% less than those of the ring. (*In Ukrainian.*) Pro napruzhenīĭ stan tsilindra konechnoĭ dovzhini. ***V. S. Sumtsov.*** *Prykladna Makhanika*, v. 4, no. 4, 1958, p. 433-441.

6726 Reinforced Concrete Fundamentals With Emphasis on Ultimate Strength. An up-to-date introduction to the fundamentals of reinforced concrete, including pertinent information on the physical behavior of reinforced concrete members. Emphasis is on the new ultimate strength concept and the manner in which beams and members fail under overload. Also included are enough details of ultimate strength design for practical use. ***Phil M. Ferguson.*** 604 pp. 1958. John Wiley & Sons, New York. (TA444 F38r)

6727 Test of Buried Structural-Plate Pipes Subjected to Blast Loading. Two 20-foot-long, 7-foot-diameter, 10-gage structural-plate pipes having longitudinal joints with 8 bolts per foot were buried and tested at nominal predicted pressure levels of 195 and 265 psi and at measured pressure levels of approximately 170 and 195 psi. Depth of burial was 10 feet. Data used in evaluating the suitability of structural-plate pipe as a partial substitute for heavy-concrete tunnel sections in the construction of scientific stations at ranges close to nuclear detonations. ***R. A. Williamson.*** *U. S. Atomic Energy Commission, ITR*-1474, Dec. 31, 1958, 44 pp. (UF767 Un3.1it Contin.)

6728 Graphic Determinations of Linear Velocities. The graphic methods discussed are: similar triangle method, Rankine's theorem, theorem of the triangle of velocities, and Burmester's theorem. ***Leo A. Padis.*** *Virginia Polytechnic Institute, Bulletin, Engineering Experiment Station Series No.* 127, Sept. 1958, 47 pp. (TN21 V81b Vis.)

METALLURGY

6729 The Seventh Coal Science Lecture—Carbon: The Key to Metallurgy. By director of the British Iron and Steel Research Association. Delivered at the Institution of Civil Engineers, London, on October 15, 1958. ***Charles Goodeve.*** *B.C.U.R.A. Quarterly Gazette*, no. 36, 1958, p. 1-11.

6730 Technical Survey. The production of copper; foundry practice; fabrication; plating and finishing; general technological properties; corrosion; joining; powder metallurgy; physical metallurgy; chemical analysis; electrical applications; mechanical engineering; building and plumbing; copper salts and compounds; and bibliography. *Copper Development Association, Technical Survey No.* 13, Jan. 1959, 36 pp. (TN780 C79t Contin.)

6731 Growth and Scaling in S.G. Iron. Determination of critical temperature ranges. ***R. J. Maitland and I. C. H. Hughes.*** *Iron & Steel*, v. 32, no. 3, Mar. 1959, p. 100-103.

6732 Special Steels for Nuclear Power. This detailed examination of the problem of special steels for nuclear engineering. ***J. A. Stafford.*** *Iron & Steel*, v. 32, no. 3, Mar. 1959, p. 106.

6733 Beryllium. A New Engineering Metal. Uses of beryllium; physical properties; mechanical properties; forming; joining; machining and grinding. ***J. W. F. Blizard, Jr. and Frank A. Twitchell.*** *Materials in Design Engineering*, v. 49, Mar. 1959, p. 91-93.

6734 Cobalt. It is felt that a deeper knowledge of the properties of cobalt-base materials could lead to a much wider use of the metal, as although it has many applications, the lack of theoretical data concerning its behavior often hinders the development of further uses. Some of the studies—relating to creep behavior, magnetic properties, catalysis, phase diagrams, structural phenomena in alloys, etc.—are of a purely scientific nature, and are not expected to lead to immediate practical results. Others are intended to develop new materials for specific uses. These include studies on cermets, heat-resisting alloys, electroplating or electrolysis deposition of cobalt alloys, creep-resisting steels, materials for airframe structures, plastics, etc. *Metallurgia*, v. 59, Feb. 1959, p. 55.

6735 Metals Technology. A recently-issued British Patent (798,341) describes an aluminum alloy for diecasting which can be anodized and dyed. *Precision Metal Molding*, v. 17, Mar. 1959, p. 32.

6736* Lightweight Metal Alloys in Printing Machine Construction. In view of the potential advantages, in terms of increased output and reduced costs, inherent in printing machinery designed to exploit fully the characteristics of light alloys, we have lately probed the machinery and metallurgical fields to discover what, if anything, is being done in this direction. *Printing World*, v. 164, no. 7, Feb. 18, 1959, p. 203 + 1 page.

6737 Structure and Properties of Zirconium Alloys. Conditions and technology of alloy preparation. Strength and plasticity at 20 and 500 C; bending and extension creep; mechanical tests. Corrosion resistance in water. Zirconium-chromium-niobium, zirconium-chromium-tin, zirconium-niobium-tin, and zirconium-molybdenum-tin systems. ***O. S. Ivanov and V. K. Grigorovich.*** *Second International Conference on the Peaceful Uses of Atomic Energy, Geneva, Sept. 1958, Paper P/2046*, 34 pp. (QC770 In8a2 Contin.)

6738* Activity of Nitrogen in Liquid Pure Iron. An experimental study was made on the equilibrium of liquid pure iron and the controlled atmosphere of N_2-A mixture or N_2 only in the range of nitrogen pressure up to 2·3 atm., in the temperature range of 1566 C to 1740 C. (*In Japanese.*) ***Yutaka Kasamatsu and Sachio Matoba.*** *Tetsu to Hagané (Journal of the Iron and Steel Institute of Japan)*, v. 45, no. 2, Feb. 1959, p. 100-105.

6739* An Outline of the Production Process of Ferro-Alloys. (*In Polish.*) Zarys procesów produkcji zelazotopów. ***Boleslaw Paczula.*** *Wiadomosci Hutnicze*, v. 15, Jan. 1959, p. 8-11.

See also: **6234** (UC ingots).

METALS—CORROSION

6740 A Study of the Corrosion of Metals in Molten Salts. The electrochemical mechanism of the corrosion has been revealed and proved, the cathodic and anodic regions of the metal in the corrosion process have been determined, a study has been made of the depolarizing action of certain compounds of practical interest, which are common impurities in technically pure chlorides, and recommendations have been made with reference to overcoming corrosion in molten salts. ***N. I. Tugarinov and N. D. Tomashov.*** Paper from "The Academy of Sciences of the USSR, Division of Chemical Science, Reports of the Fourth Soviet Conference on Electrochemistry, Oct. 1-6, 1956", Consultants Bureau, Inc., New York, 1958, p. 16 + 1 page. (QD552 So89ttr)

6741 The Mechanism of the Electrolytic Oxidation of Certain Compounds on Platinum. A study has been made of the processes involved in the electrolytic oxidation of saturated monohydric alcohols and the corresponding aldehydes. The separate stages of the complex process have also been studied, with the use, in particular, of special methods. The poisoning method has been widely employed. An examination of the experimental data leads to the conclusion that an electron-radical mechanism operates for the majority of the substances studied. Certain ideas on the general nature of the mechanism of electrolytic oxidation have been put forward in connection with the experimental material presented above. ***A. I. Shlygin and G. A. Bogdanovskii.*** Paper from "The Academy of Sciences of the USSR, Division of Chemical Science, Reports of the Fourth Soviet Conference on Electrochemistry, Oct. 1-6, 1956", Consultants Bureau, Inc., New York, 1958, p. 32. (QD552 So89ttr)

6742 The Anodic Passivity of Metals in Aqueous Solutions. The contradictory nature of existing ideas on the mechanism of passivity and the nature of the passive state provides evidence for the complexity of the phenomenon and our lack of knowledge of the electrochemical behavior of metals in the field of passivity. The electrochemical methods used until recently in the study of the passivation of metals (charging curves, polarization curves) insufficiently characterize this behavior. ***Ia. M. Kolotyrkin.*** Paper from "The Academy of Sciences of the USSR, Division of Chemical Science, Reports of the Fourth Soviet Conference on Electrochemistry, Oct. 1-6, 1956", Consultants Bureau, Inc., New York, 1958, p. 35. (QD552 So89ttr)

6743 High-Temperature Oxidation and Contamination of Niobium. The oxidation and contamination rates of niobium in oxygen and in air were measured in the temperature range 600 and 1200 C. The oxidation curves in oxygen were linear and the rate constants were correlated by an Arrhenius-type plot. The heat of reaction was 5,410 cal per mole from 600 to 1100 C; above 1100 C the reactions were rapid and the rates could not be correlated to the Arrhenius-type plot. The activation energy for diffusion of oxygen in niobium was calculated from contamination data. Weight-change curves of niobium in air were also linear, with lower rates than in oxygen. The heat of reaction was, from the reaction rate data, 10,100 cal per mole from 600 to 1200 C. Contamination in air-reacted niobium was similar to that in oxygen-reacted niobium, suggesting that oxygen is the primary diffusing contaminant. ***William D. Klopp, Chester T. Sims, and Robert I. Jaffee.*** *American Society for Metals, Transactions*, v. 51; *Preprint No.* 64, Aug. 7, 1957, 27 pp. (TS300 Am35t Vis.)

6744 Studies of the Oxidation and Contamination Resistance of Binary Niobium Alloys. A study of the effects of binary alloying additions on the oxidation and contamination resistance of niobium has been conducted. The alloys contained up to 35 a/o titanium, chromium, and zirconium, 25 a/o vanadium, molybdenum, tantalum, and tungsten, and 5 a/o beryllium, boron, cobalt, iron, manganese, nickel, and silicon. The oxidation and contamination studies were conducted in air at 600, 800, and 1000 C. Contamination was investigated by hardness-penetration measurements on all oxidized alloys except those containing beryllium or boron. Zirconium and titanium markedly reduced the depth of oxygen contamination resulting from exposure to air. Diffusion coefficients for oxygen in the niobium binary alloys were calculated, and related by activation-energy plots where possible. Zirconium, titanium, chromium, and vanadium were most effective in reducing oxygen diffusion into niobium. ***Chester T. Sims, William D. Klopp, and Robert I. Jaffee.*** *American Society for Metals, Transactions*, v. 51; *Preprint No.* 70, Aug. 1, 1957, 33 pp. (TS300 Am35t Vis.)

6745 The Use of Stainless Steels in Corrosion Control. The stainless steels have found wide usage in the chemical industry, the pulp and paper industry, the food handling industry, and as architectural trim. However, until very recently the mining industry has been slow to use them. Even today their quantity use is limited to milling uranium ores and handling certain acid mine waters. They are a relative newcomer to mining and their properties should be studied carefully to determine where they can be used to save money. Discusses intergranular corrosion, pitting corrosion, crevice cor-

rosion and resistance to several specific chemical solutions. ***J. P. Ogilvie.*** *Canadian Mining and Metallurgical Bulletin*, v. 52, no. 562, Feb. 1959, p. 85-89; *Canadian Institute of Mining and Metallurgy, Transactions*, v. 62, 1959, p. 17-21.

6746 High-Nickel Alloys in the Petroleum Industry. I. Applications of Monel and other nickel alloys in petroleum production are considered. ***G. L. Swales.*** *Corrosion Technology*, v. 6, Mar. 1959, p. 81-84.

6747 Resistance of Cobalt to Certain Solutions. This article describes some tests which were carried out in Canada to obtain data on the effect of different solutions on cobalt. The solutions included 10% by volume NaOH, concentrated and 1:1 HF, concentrated and 1:1 H_3PO_4, 5% aqueous solution of hydrazine, and distilled water. ***R. S. Young.*** *Corrosion Technology*, v. 6, Mar. 1959, p. 89.

6748 Two-Stage Self-Sustained Reaction Between Molybdenum and Potassium Permanganate: Kinetics of the First Stage. Self-sustained reaction between molydenum and potassium permanganate has been investigated by the temperature-profile method. ***R. A. W. Hill and J. N. Welsh.*** *Faraday Society, Transactions*, v. 55, Feb. 1959, p. 299-305.

6749 Oxidation of Metals. A fundamental review of theory; metal oxides, metal oxidation, and alloy oxidation. ***Walter W. Smeltzer and Lyndon H. Everett.*** *Industrial and Engineering Chemistry*, v. 51, Mar. 1959, pt. II, p. 406-411.

6750* Enamel Problems With Electrolytic Tin Plate. They were many and difficult, but tremendous progress has been made. ***Henry A. Bates.*** *National Lithographer*, v. 66, Mar. 1959, p. 49 + 2 pages.

6751 In Refining and Petrochemical Plants: Corrosion Exists in Many Forms. Three main types according to environment are: (1) atmospheric, (2) fluid, and (3) soil corrosion. ***John C. Kuli and John L. McPherson.*** *Petroleum Engineer*, v. 31, Mar. 1959, p. C6-C11.

6752 What Trans-Canada Is Doing to Protect Its System Against Corrosion. Covering 2290 miles, much of the route through rugged terrain, this pipeline is subjected to every known type of galvanic corrosion process. ***Lance F. Heverly.*** *Petroleum Engineer*, v. 31, Mar. 1959, p. D22-D27.

6753* Internal Coating of Pipe Lines. What Does the Future Hold? There are at least five factors which either individually or collectively will influence the justification and future acceptance of internal plastic type coatings by pipeline owners. Each operating situation or purpose will need individual evaluation to determine the advantages most necessary to be gained. The advantages most important in one case may present no merit in another case. ***Warren D. Palmer.*** *Pipe Line News*, v. 31, Mar. 1959, p. 38 + 2 pages.

6754* Pipeline Corrosion—A Practical Example of Its Control. A Montreal plant recently experienced a complete and unexpected shut down of all the major processing units due to corrosion of an underground raw material supply line. It is believed that an account of the failure and the subsequent investigation, together with the application of well known corrosion prevention principles, will be of interest to all corrosion engineers as a practical example of the application of their particular branch of engineering. ***R. F. U. Icely.*** *Pipe Line News*, v. 31, Mar. 1959, p. 41 + 3 pages.

6755* Behavior of Magnesium and Two of Its Alloys Heated in Carbon Dioxide. Magnesium specimens either pure or lightly alloyed with Zr and Zn were exposed to CO_2 under a pressure of 15 kg. per sq. cm. for 3,000 hours at from 400 to 500 C. The weight-increase curves show that oxidation remains slight; with increased temperature the plateau is raised and is reached more rapidly. Nevertheless, a deposit of C appears at 450 C and upwards, and the presence of Zn causes marked sublimation above 550 C. Further, it has also been shown that distinct proportions of O, N or air in the CO_2 do not appreciably increase oxidation, even at 500 C. (*In French.*) Comportement du magnésium et de deux alliages de magnésium chauffés dans le gaz carbonique. ***M. L. Boussion, R. Darras, and D. Leclerq.*** *Revue de Métallurgie*, v. 56, Jan. 1959, p. 61-67.

6756* Protection Against Corrosion Fatigue. Corrosion fatigue, which occurs with steels subjected to alternate stressing in the presence of soft water, has the effect of causing the disappearance of the fatigue limit; rupture inevitably occurs after a certain number of cycles which is greater the lower the stress. Paint coatings have practically no notable protective effect; copper plating has a certain, though very limited beneficial effect; electrolytic zinc coating has an excellent effect if followed by chemical chromating; finally, compressive prestressing is very effective if service conditions do not cause the disappearance of the residual stresses; for this purpose, cyaniding and nitriding are particularly efficaceous. (*In French.*) Protection contre la fatigue corrosion. ***A. Royez and J. Pomey.*** *Revue de Métallurgie*, v. 56, Feb. 1959, p. 122-128.

6757 Chalk River Experience With Zircaloy-2 and Aluminum-Nickel-Iron Alloys in High-Temperature Water. Chalk River's interest in the corrosion of aluminum and zirconium alloys in high temperature water results from a decision to build nuclear power reactors cooled and moderated with heavy water. A list has been given elsewhere of sheath failures experienced at Chalk River in testing experimental UO_2 fuel sheathed in Zircaloy. Such failures have been very infrequent, but are, of course, of great interest from the standpoint of fuel design. Much of the experimental work on the corrosion of Zircaloy has been done with a view to establishing the mechanism of known failures. ***F. H. Krenz, G. J. Biefer, and N. A. Graham.*** *Second International Conference on the Peaceful Uses of Atomic Energy, Geneva, Sept. 1958, Paper P/194*, 21 pp. (QC770 In8a2 Contin.)

6758 Oxidation and Contamination Reactions of Niobium and Niobium Alloys. Niobium was found to react linearly with air (600 to 1200 C) and with oxygen (400 to 1400 C). Alloying effects could be correlated with relative ionic size and valence of the alloy addition and with properties of the alloy-element oxides. The most effective binary additions for improving oxidation resistance were chromium, molybdenum, titanium, and vanadium. ***William D. Klopp, Daniel J. Maykuth, Chester T. Sims, and Robert I. Jaffee.*** *U. S. Atomic Energy Commission, BMI-1317*, Feb. 3, 1959, 76 pp. (UF767 U3b Contin.)

See also: **6264** (radiant heating corrosion control); **6446** (internal corrosion control in oil pipelines).

METALS—EXTRACTION AND REFINING

6759 The Part Played by the Metal-Molten Salt Equilibrium in Electrode Processes. Taking the electrolysis of cryolite-alumina melts as an example, it has been shown that the cathodic current efficiency is determined by the degree of preliminary saturation of the molten electrolyte by the metal. ***L. N. Antipin.*** Paper from "The Academy of Sciences of the USSR, Division of Chemical Science, Reports of the Fourth Soviet Conference on Electrochemistry, Oct. 1-6, 1956", Consultants Bureau, Inc., New York. 1958, p. 18. (QD552 So89ttr)

6760 The Simultaneous Discharge of Ions and the Problem of Preparing Metals of High Purity. The theoretical foundations of the processes for preparing metals of high purity at a cathode, from the electrochemical point of view, are chiefly those related to the problem of the simultaneous discharge of ions. The general equations which have been derived for simultaneous discharge under refining conditions, on the basis of the theory of retarded discharge and concentration polarization, have been confirmed by observations on the inclusion of impurities in cathodic deposits during the preparation of high-purity nickel, cobalt, and tin. ***A. L. Rotinian and V. L. Kheifets.*** Paper from "The Academy of Sciences of the USSR, Division of Chemical Science, Reports of the Fourth Soviet Conference on Electrochemistry, Oct. 1-6, 1956", Consultants Bureau, Inc., New York. 1958, p. 81. (QD552 So89ttr)

6761 The Use of a New Electrolyte in Nonferrous Metallurgy. I. The Electrolytic Refining of Lead. II. The Electrolytic Refining of Tin. On the basis of laboratory studies in nonferrous metallurgical plants, Gintsvetmet (State

Institute for Nonferrous Metallurgy) have carried out tests on the electrolytic refining of lead containing Sb, Ag, and Bi, in a sulfamino electrolyte. The tests have shown the following advantages of the sulfamino electrolyte: (a) the possibility of refining lead containing a high percentage of impurities; (b) the absence of anodic passivation and the fall of sludge from the anode at the current densities usually employed in practice; (c) the good quality of the cathode deposit; (d) the low voltage in the bath; (e) the high lead current efficiency at the cathode; (f) the low toxicity of the electrolyte. A study has been made of the following: (a) the electrical conductivity, viscosity and hydrolysis of the sulfamino electrolyte, the polarization of lead electrodes in this electrolyte in relation to the temperature and electrolyte composition; (b) the reason for the varying behavior of the anode sludge in the electrolytic refining of lead in different electrolytes; (c) the influence of added surface-active materials, in the electrolytic refining of lead in a sulfamino electrolyte, on the nature of the cathode surface, the voltage in the bath, the electrical conductivity of the electrolyte and the polarization of the electrodes. A process has been worked out for the electrolytic refining of crude tin in a sulfamino electrolyte, which leads to an improvement in the extraction of tin into ready-made goods by comparison with existing thermal refining, and to the concentration of all the impurities present in the crude tin, into a small amount of slag. The process is characterized by a high tin current efficiency ($> 90\%$) and enables tin of grade 0-1 to be prepared. The process is being adopted in plant at the present time. ***N. B. Pleteneva.*** Paper from "The Academy of Sciences of the USSR, Division of Chemical Science, Reports of the Fourth Soviet Conference on Electrochemistry, Oct. 1-6, 1956", Consultants Bureau, Inc., New York. 1958, p. 81-82. (QD552 So89ttr)

6762 A Review of Self-Fluxing Sinter Applications. Sintering has been recognized as a prominent means of beneficiating ores for a blast furnace. Though less widely realized, sintering has been used for beneficiating both ore and flux. Thus, through the use of self-fluxing sinter, several duties of the blast furnace have become relieved, i.e., calcination and vitrification of the limestone. ***Thomas E. Ban.*** *Blast Furnace and Steel Plant*, v. 47, Mar. 1959, p. 294-302.

6763 Problems of the Use of Vacuum in Metallurgy. Introductory chapter of a collection of papers (to be offered individually as Brutcher translations) giving (1) a general evaluation of the status of vacuum melting and pouring, and equipment in the Soviet Union; (2) the highlights of some worthwhile Russian work; and (3) a comparative appraisal of the present state of the art in the USSR as against some Western countries. ***A. M. Samarin.*** *Henry Brutcher Translation No.* 4361, 17 pp. (From *Primenenie Vakuuma v Metallurgii*, 1958, p. 3-13.) Henry Brutcher, Altadena, Calif.

6764 Vacuum Treatment of Alloy Steels. Operating data on the ladle degassing of a structural 0.30% C, 1 Mn, 1.1 Si, 0.9 Cr steel and a 1% C, 1.5 Cr bearing steel. Macrostructure, surface quality, and mechanical properties of air vs. vacuum poured steels. ***G. A. Sokolov, G. N. Oiks, and I. I. Ansheles.*** *Henry Brutcher Translation No.* 4423, 10 pp. (From *Metallurg*, no. 10, Oct. 1958, p. 10-14.) Henry Brutcher, Altadena, Calif.

6765 Reduction of Titanium and Silicon Dioxides With Magnesium at Normal Pressure. Particulars on the magnesiothermal reduction experiments. Purification of the titanium and silicon obtained. ***W. Rutkowski.*** *Henry Brutcher Translation No.* 4436, 11 pp. (From *Prace IMH*, v. 8, no. 2, 1956, p. 85-88.) Henry Brutcher, Altadena, Calif.

6766 Electron Bombardment Apparatus for Vacuum Evaporation. Simple experimental arrangements are described for the evaporation of tantalum and zirconium from a pendant drop, maintained molten by electron bombardment. The method is clearly of general application and has advantages over existing techniques. Since there is no boat or container there is no possibility of solution of the boat material and consequent contamination of the evaporant. The material to be evaporated is used in wire or rod form; these may be very easily interchanged. ***J. C. Kelly.*** *Journal of Scientific Instruments*, v. 36, Feb. 1959, p. 89-90.

6767* Contribution to the Study of the Preparation of Zirconium and Some of Its Alloys by Metallo-Thermic Reduction. A direct process preparing Zircaloy in the massive form by calcium reduction is described: zirconium tetrafluoride is reduced in presence of the alloying metals. The metallurgical yield is excellent, although no booster was used. However, it seems necessary to use calcium with lower oxygen content in order to prepare ductile ingots. Several theoretical developments about metallothermic reactions and further details about a method for purifying zirconium tetrafluoride are given. Some experimental techniques are described. (*In French.*) Contribution à l'étude de la préparation du zirconium et de certains de ses alliages par réduction métallothermique. ***Claude Decroly, Jean Gérard, and Denis Tytgat.*** *Revue de Métallurgie*, v. 56, Feb. 1959, p. 143-162.

6768* Influence of Purity and Structural State of Iron on Its Capacity of Cathodic Hydrogen Occlusion. Zone melting iron occludes very small quantities of hydrogen. Polygonized iron occludes a smaller quantity of hydrogen than does the same non-polygonized iron. Sodium sulfur added to electrolytic solution increases the quantity of hydrogen occluded by the classification of purity degrees of iron established in former experiments has not varied. Autoradiographic studies of iron charged in presence of ^{35}S show the intergranular penetration of this element. (*In French.*) Influence de la pureté et de l'état structural du fer sur son aptitude au chargement en hydrogène cathodique. ***Simone Besnard and Jean Talbot.*** *Revue de Métallurgie*, v. 56, Feb. 1959, p. 163-170.

6769* Contribution to the Study of Steel Making Processes. The characteristic differences in the metallurgical reactions between the bottom-blowing air-refining and hearth-refining processes are caused by the fundamentally different way of supplying oxygen. Dephosphoration reaction and decarburization. The mechanical aspect of the classic refining processes and conclusions to be drawn for the new oxygen steel making processes. (*In German.*) Beitrag zur Dynamik der Stahlgewinnungs-Verfahren. ***Von Werner Heischkeil and Theo Kootz.*** *Stahl und Eisen*, v. 79, no. 4, Feb. 19, 1959, p. 205-210.

6770 Electric Furnaces to Gain in Direct Reduction of Ore. They can be used to supplement blast furnace output or to supply hot metal in small shops; relatively little capital is needed; ore doesn't have to be uniform. Reduction of iron ore in the electric furnace or by other direct reduction processes usd with it should gain popularity in 1959. *Steel*, v. 144, Mar. 16, 1959, p. 122 + 3 pages.

6771* Fundamental Researches on Smelting of Sulphide Ores. XIV. On Molten Copper Sulphide. From the chemical thermodynamic point of view, the behavior of molten copper sulfide at high temperature was studied by measuring the equilibria of H_2S/H_2 gas mixtures with the melts from the compositions concerning the two liquid region to those close over cuprous sulfide in the Cu-S system by a flow method at temperatures of 1,135, 1,185, and 1,230 C. The results obtained for the melts in the two liquid region showed a linear relation of $\log(H_2S/H_2)$ vs $1/T$. This leads to the following equation for the sulfur pressure in this range:

$$\log P_{s_2} = -\frac{15{,}398}{T} + 4.476.$$

Basing on the present results, some related thermodynamical quantities were calculated and further discussion was made on the portion of the Cu-S system taking part in the melt. ***Kingo Sudo.*** *Tôhoku University, Science Reports of the Research Institutes, Ser. A. Physics, Chemistry, Metallurgy*, v. 10, no. 6, Dec. 1958, p. 435-452.

6772* Preparation of Zinc Sulfide Single Crystals. Rod crystals of ZnS were prepared by the gas reaction (Frerichs) and the sublimation (Kremheller) methods. The former method was capable of growing crystals of nearly 8 x 0.3 x 0.1 mm. from pure Zn metal kept at 1,100 C for only half an hour in H_2S gas atmosphere. The latter method enabled us to obtain crystals (5-8 mm. in length and 0.3-1 mm. in sectional diameter) from ZnS powder kept at 1,220 C for 8 hours in an inert gas stream. It was found that relatively large crystals grew under steady condition at just above sublimation temperature. Crystals obtained by the sublimation method displayed electroluminescence at excitation of both ac and dc, without any activator. The growth conditions of needle, twin and ribbon crystals were also discussed. ***Tetsuo Matsumura,***

Haruo Fujisaki, and Yasaku Tanabe. *Tôhoku University, Science Reports of the Research Institutes, Ser. A. Physics, Chemistry, Metallurgy*, v. 10, no. 6, Dec. 1958, p. 459-471.

See also: **6574** (direct reduction); **6872** (continuous casting of Al).

METALS—FOUNDRY PRACTICE

6773 The Decomposition Voltage of Nonferrous Metallurgical Slags and Their Properties. The presence of ions in metallurgical slags opens the possibility of studying them by electrochemical methods and of finding ways to reduce the loss of valuable metals. The addition of alumina to the slag brings about an increase in the activity of the iron in the slag. ***V. L. Kheifets and S. E. Vaisburd.*** Paper from "The Academy of Sciences of the USSR, Division of Chemical Science, Reports of the Fourth Soviet Conference on Electrochemistry, Oct. 1-6, 1956", Consultants Bureau, Inc., New York. 1958, p. 20. (QD552 So89ttr)

6774 Vacuum Melting of Steels. The consumable-electrode vacuum-arc process has two inherent advantages over the vacuum-induction process: (a) no refractory materials are used, (b) owing to the progressive freezing of the ingot, segregation and central porosity are minimized. The relative advantages of the consumable-electrode and the induction process are listed. ***H. C. Child and G. T. Harris.*** *Blast Furnace and Steel Plant*, v. 47, Mar. 1959, p. 281-290.

6775 Design of a Vacuum Installation for Pouring Ingots of up to 120 Tons. Design details of chamber proper, cover, and teeming ladle. Special features. Evacuation system. Description of cooling and filtering unit for gases drawn out of chamber. ***V. K. Novitskii.*** *Henry Brutcher Translation No.* 4372, 7 pp. (From *Primenenie Vakuuma v Metallurgii*, 1958, p. 107-111.) Henry Brutcher, Altadena, Calif.

6776 Lift of Ingot Moulds and Stools. How improved life of heavy slab-type ingot molds was obtained by changing the design, and how the life of stools was improved by incorporating a reinforcing band. ***D. M. Slonim.*** *Foundry Trade Journal*, v. 106, Mar. 12, 1959, p. 295-299.

6777 Surface Defects in Ingots and Their Products. *Iron and Steel Institute, Special Report No.* 63, 1958, 58 pp. (TN601 I6s Vis.)

6778* Factors Influencing Soundness of Gray Iron Castings. An important finding is that increasing the degree of nucleation of the graphite eutectic leads to unsoundness. This is a common foundry variable which can be measured, and is amenable to some control. ***I. C. H. Hughes, K. E. L. Nicholas, A. G. Fuller, and T. J. Szajda.*** *Modern Castings*, v. 35, Mar. 1959, p. 73-89.

6779* Starch Content Effect on a Rammed Graphitic Mold Material for Casting Titanium. A mixture containing 6% starch and molded at 120 psi. provided molds which were equivalent to machined graphite molds with respect to minimizing surface contamination of resulting titanium castings. It has been found that mold shrinkage is directly proportional to starch content and inversely proportional to molding pressure. ***H. W. Antes and R. E. Edelman.*** *Modern Castings*, v. 35, Mar. 1959, p. 97-102.

6780 Modern Pearlitic Malleable Castings Handbook. 74 pp. 1958. Malleable Research and Development Foundation, Granville, Ohio. (TS305 M29m)

6781 The Physical Chemistry of Steelmaking. A series of papers on liquid metals and properties of solutes in liquid iron and steel; equilibria of reactions in liquid iron and steel; behavior of metal oxides and of components of iron and steelmaking slags; slag-metal equilibria in blast-furnace and steelmaking furnace systems; kinetics and slag-metal reactions; reaction rates in iron and steelmaking processes; application of fundamental data to process development and metallurgical problems in the steel industry; solidification of castings and ingots; research planning; and kinetic problems in steelmaking. ***John F. Elliott, editor.*** 251 pp. 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6782 An Adiabatic Dropping Calorimeter for Enthalpy Measurements at High Temperatures. The Heat Content of Silicon From 1200 to 1550°C. The study of the thermodynamic properties of the elements and of inorganic compounds has been the object of numerous experimental investigations especially during the last fifty years. In the United States, in particular, important work has been carried out in the laboratory of Dr. K. K. Kelley to whom we also owe the publication of wide critical selections of the best experimental data. Such compilations have become the major tool of all thermodynamic calculations concerning metallurgical processes. Careful examination, however, shows how incomplete our knowledge of thermodynamic constants still is, notably concerning enthalpies and specific heats of substances entering iron, steel, blast-furnace, and steelmaking slags in the range of metallurgical temperatures. With the purpose of measuring heat contents of substances of interest in steelmaking, a copper-block dropping calorimeter has been built. The experiments were performed under adiabatic conditions, and the determination of the calorimeter temperature was made by means of a thermistor. Among the elements for which calorimetric data are scarce at high temperatures, silicon was selected first. The enthalpy data presented here were obtained at temperatures as high as 1550 C on a very pure silicon containing over 99.99% silicon. The results can be summarized in the two following relations where enthalpy is in cal/gram atom and temperature in °C: Solid state (from 1200 C): $H\theta - H_{25} = 6.53\theta - 652$; Liquid state (up to 1550 C): $H\theta - H_{25} = 6.12\theta + 12{,}024$. The enthalpy vs. temperature curve yielded the melting point of silicon, 1412 ± 2 C, and its heat of fusion, 12,095 ± 100 cal. ***M. Olette.*** Paper from "The Physical Chemistry of Steelmaking", p. 18-26, 1958. The Technology Press of The Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6783 Surface Tension of Pure Liquid Iron, Cobalt, and Nickel at 1550°C. It has recently been shown that the considerable lowering of the surface tension of liquid Fe and Fe-C alloys by S and O may be of vital importance in such varied phenomena as iron emulsification (iron shot) in slags and formation of nodular graphite. An exact knowledge of the surface tension of pure liquid Fe is of course necessary if the lowering action of very small quantities of surface-active substances is to be measured. The surface tension of pure liquid Fe, Co, and Ni has been measured at 1550 C by the sessile-drop method. By control of the atmosphere (partial pressure of O less than 10^{15} atm) and use of pure oxide refractories, it was possible to obtain less than 0.001% dissolved O in the drop. The "capillary constant" of Fe, $a^2 = \gamma/gd$, was found to be 26.0 mm^2 and the surface tension (density 7.2) γ = 1835 dyne cm^{-1}. For cobalt, a^2 = 25.3 mm^2, and γ = 1936 dyne cm^{-1} (density 7.8). For nickel, a^2 = 25.8 mm^2, and γ = 1924 dyne cm^{-1} (density 7.6). ***P. P. Kozakevitch and G. Urbain.*** Paper from "The Physical Chemistry of Steelmaking", p. 27-34, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6784 The Carbon-Oxygen Equilibria in Liquid Iron. The carbon-oxygen equilibria have been selected as the primary topic for this introductory paper to the present session "Equilibria of Reactions in Liquid Iron and Steel" because it appears that the reactions involved will be a major topic of discussion during the Conference. Specifically there seems to be a number of unanswered questions concerning the reasons for the apparent sluggishness of the reaction of C with O in iron and steelmaking systems. The result of this analysis of available data on the Fe–O–C system in the vicinity of 1600 C has been a series of graphical illustrations showing various thermodynamic relationships for the reactions between C and O. Consequently, the reader is referred to the figures in the paper as a summary. ***J. F. Elliott.*** Paper from "The Physical Chemistry of Steelmaking", p. 37-41, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6785 Equilibrium of Carbon and Oxygen in Molten Iron Saturated With Carbon (II)—The Effect of Silicon in the Range of 0 to 5.20%. The effects of silicon on the equilibrium

between carbon and oxygen in molten iron, saturated with carbon and under conditions such that SiO_2 or SiC were not formed, were investigated. ***S. Matoba and S. Ban-ya.*** Paper from "The Physical Chemistry of Steelmaking", p. 42-45, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6786 The Alumina-Graphite Reaction in Liquid Iron and the Aluminum Deoxidation Constant in Steelmaking. There is an increasing knowledge of the interactions between two or more dissolved elements in liquid iron. Besides the usefulness of these data in studying alloy behavior in steel baths, they also make it possible to bring together the data on simple and complex ferrous systems into a coherent body. Knowledge of the interaction between certain elements and dissolved carbon makes possible a comparison of experimental results in carbon-free systems with those obtained under conditions of carbon saturation. Thus data drawn from researches which are primarily aimed at blast-furnace problems may be utilized to supplement experiments on reactions of steelmaking. Al_2O_3-saturated Al_2O_3–SiO_2–CaO slags were equilibrated with graphite-saturated Fe–C–Si–Al melts at 1600 and 1700 C, the reaction Al_2O_3 (in slag) = 2[Al] + 3[O] studied. Since the slags were saturated with Al_2O_3, $a_{Al_2O_3} = 1$, and the equilibrium constant for the above reaction reduces to $K = a_{[Al]}^2[a_O]^3$. The activity of oxygen was evaluated by combining equations to obtain ΔF° for the reaction C (graphite) + [O] (in Fe) = *CO* (g). The metal was saturated with carbon and under 1 atm of CO, making a_C and a_{CO} unity. Thus, a_O was evaluated without analyzing for oxygen. The activity of Al was determined from the analyses for aluminum and the known effects of carbon and silicon on γ_{Al}. The aluminum concentrations were higher than when pure iron is equilibrated with pure Al_2O_3, and this reduced the uncertainty caused by analyzing for very small quantities of aluminum. Utilizing a_O and a_{Al}, the aluminum deoxidation constant, $[a_{Al}]^2[a_O]^3$, was found to be 3.6×10^{-14} at 1600 C and 2.8×10^{-13} at 1700 C. ***J. Chipman and F. C. Langenberg.*** Paper from "The Physical Chemistry of Steelmaking", p. 46-50, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6787 Oxide Slags—A Survey of Our Present Knowledge. During the past fifteen years the understanding of the fundamental principles of slag behavior has developed very considerably. There is still a long way to go; as the picture unfolds, so does it become both more complex and more interesting. Those who pursue research on silicates and slags can still expect a stimulating as well as a difficult time. ***F. D. Richardson.*** Paper from "The Physical Chemistry of Steelmaking", p. 55-62, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6788 A Summary of Some Experimental Work on the Activity of Silica in Liquid Silicate Systems. The activity of silica in the liquidus of the CaO–SiO_2 system at 1637 C has been determined by the use of the Knudsen Cell to measure the pressures of SiO and O_2 above the melt and above pure cristobalite. Details of the experimental procedure and calculations will be given in a later publication. In general, the trend of the activity versus mole fraction plot follows the expected behavior. The activity of silica obtained in this investigation, at the point where dicalcium silicate forms as a separate phase, lies between the activities of silica calculated by Darken and by Richardson. However, it is considerably higher than the results of Chipman and Fulton. The source of this discrepancy is at present unresolved. ***L. Yang, C. L. McCabe, and R. Miller.*** Paper from "The Physical Chemistry of Steelmaking", p. 63-64, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6789 The Activity of Silica in Lime-Alumina-Silica Slags at 1600°C. This preliminary note presents briefly the results of additional silicon-distribution studies at 1600 C which permit determination of the activity of silica over a wider range than previously reported. The new results are part of a large body of data which extend the silicon-distribution data at 1600 and 1700 C for CaO–Al_2O_3–SiO_2 slags over a range from zero % Al_2O_3 to Al_2O_3 or $CaO.2Al_2O_3$ saturation. The upper limit of SiO_2 is still set by the occurrence of SiC as a stable phase when the metal contains 23.0 or 23.7% silicon at 1600 or 1700 C, respectively. The total results will be combined in the near future to calculate the activity of CaO and Al_2O_3 in these slags from the activity of SiO_2. ***F. C. Langenberg, H. Kaplan, and J. Chipman.*** Paper from "The Physical Chemistry of Steelmaking", p. 65-67, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6790 Activities in Ternary Silicate Melts. An understanding of the manner in which the activities of metal oxides and silica vary with composition in ternary and complex silicate melts is of great importance to both the extraction metallurgist and the chemist interested in molten salts. Measured activities of FeO and MnO in the ternary melts FeO–CaO–SiO_2 and MnO–CaO–SiO_2 support this conclusion, and mixing appears to be approximately ideal over the composition range $N(SiO_2) = 0.58$ to 0.42. It is suggested that the excess free energies of mixing near the orthosilicate compositions arise from better packing of mixed than of uniform cations in the anionic silicate matrix. In a mixture of two melts of equal silica molar fraction, the logarithm of the activity of silica is a linear functions of the proportions of the two metal oxides, in the region of "near-to-ideal" mixing. The activity coefficient is raised for that metal oxide which in its binary melt (with silica) has the higher silica activity, and vice versa. The changes will be greater, the greater the differences between the silica activities in the binary melts. ***F. D. Richardson.*** Paper from "The Physical Chemistry of Steelmaking", p. 68-76, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6791 Comments on the Equilibrium Diagram Al_2O_3—SiO_2. The composition has been checked after the final heating, for example, at 1830 C, since it is known that SiO_2 evaporates easily at such a high temperature. Few SiO_2 losses are noticeable. They become much greater if the sample is completely melted and heated to higher temperatures. Further, it was established that alkalies were not absorbed by the samples by heating up to 28 hrs. ***G. Trömel.*** Paper from "The Physical Chemistry of Steelmaking", p. 77-78, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6792 Electrical Measurements on Oxides and Solid Cells at Temperatures of 1200 to 1800°C. For the study of the behavior of oxides at high temperatures, we used solid cells of the general type Pt/MeO + Me_2O_3/Me_2O_3/Pt and with these carried through measurements in the systems FeO–Al_2O_3 and MgO–Al_2O_3 at 1500 C. A report on these measurements has already been given. Therefore this report is restricted to a representation of the essential results. ***W. A. Fischer.*** Paper from "The Physical Chemistry of Steelmaking", p. 79-83, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6793 The Action of Calcium Fluoride in Slags. Calcium fluoride has primarily a twofold action in slags: (1) It lowers the melting point of slags, so that slags of higher basicity can be used. (2) It decreases the viscosity. It appears that secondary chemical reactions between calcium fluoride and slags can occur. ***T. Baak.*** Paper from "The Physical Chemistry of Steelmaking", p. 84-86, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6794 Formation and Destruction of Foams and Emulsions in Iron and Steelmaking. The presence of foams and emulsions in iron and steelmaking systems has long been a problem with which only the furnace operator has been concerned. Very little attention has been paid to them by the scientist in the interest of understanding how to cause them to form, how to prevent them, and how to destroy them once they form. In general, they are undesirable because a foam, which is a mixture of gas bubbles in a liquid phase, makes heat transfer through the slag layer difficult. An emulsion of metal

in liquid slag can cause serious losses in yield. Nevertheless, these conditions provide a tremendous surface area for reaction between the two phases which could be of economic advantage. It is the purpose of this paper to discuss informally some observations which have been made on foams and emulsions. ***P. P. Kozakevitch.*** Paper from "The Physical Chemistry of Steelmaking", p. 89-92, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6795 Slag-Metal Reactions of Chromium in Carbon-Saturated Melts. The iron-chromium-oxygen system has been studied intensively under conditions typical of the refining, deoxidation, and solidification of steel. For practical purposes, the recovery of chromium in the metal should be nearly complete under strongly reducing conditions similar to those in the hearth of a blast furnace. ***C. W. McCoy and W. O. Philbrook.*** Paper from "The Physical Chemistry of Steelmaking", p. 93-98, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6796 Kinetics of Metallurgical Reactions With Particular Reference to the Open Hearth. The general picture of the boil at steady state may be formulated by starting with this turbulence. The turbulence, in conjunction with the properties of the metal as viscosity and diffusivity, then may be regarded as primarily responsible for the thickness of the boundary films. These, in turn, control the rate of passage of heat and of oxygen and, hence, the rate of evolution of CO. Also, intimately connected with this is the rate of generation of CO bubbles, which is connected with cracks, crevices, and surface tension. The rate of evolution of CO determines the amount of turbulence. This brings one back to the arbitrary starting point. It is quite clear that a balance is struck—i.e., a definite rate of boil is established—such as to satisfy all these requirements simultaneously. Thus, no one factor can be said to determine the rate of boil—all must be considered jointly. ***L. S. Darken.*** Paper from "The Physical Chemistry of Steelmaking", p. 101-108, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6797 Kinetic Factors in the Desulfurization of Pig Iron by Blast-Furnace Type Slags. Experiments have been made to help clarify the mechanism of sulfur transfer between liquid pig iron and blast-furnace type slags. Except for one run with no stirring, all experiments were made under conditions of forced convection by means of a graphite stirrer. With 6% Si in the metal to maintain equilibrium with SiO_2 in the slag, the transfer rate is slightly affected by stirring rate. To this extent, the process, under constant chemical conditions, is diffusion controlled. Bubbling CO through the bath was without effect. Omission of Si from the charge causes a drastic slowing of the reaction, indicating the overriding importance of chemical factors in determining the rate of transfer. ***J. C. Fulton and J. Chipman.*** Paper from "The Physical Chemistry of Steelmaking", p. 113-116, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6798 The Deoxidation of Iron Melts With Silicon. It was intended to examine what kind of inclusions are formed during the different periods of time and in the different crucibles during the course of the reaction. Observations made on the deoxidation products obtained during the reaction. Here the following kinds should be distinguished: (1) Products resulting from melts before the silicon addition. (2) Products resulting from melts with primary segregations. (3) Products from melts without primary segregations. The inclusions of the melts originating from the switched-off furnace are on the average bigger than those from the agitated melts. Here, furthermore, often rather strange intermediate shapes occur if several inclusions are fusing together. Figure 14 shows the process of the formation of inclusions during the cooling of the melts. A great number of small inclusions grow together into bigger inclusions. A clear distinction between the primary inclusions segregating out immediately after the silicon addition and the secondary inclusions formed during cooling and solidification, however, could not be made. ***W. A. Fischer.*** Paper from "The Physical Chemistry of Steelmaking", p. 117-122, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6799 Electrochemical Nature of Sulfur Transfer in the System Carbon-Saturated-Iron-Slag. Reactions between two liquids such as a slag and an alloy often prove relatively easy to study if knowledge of equilibrium conditions is sought. In view of the approximations involved in the theoretical treatment and the experimental inaccuracies, which are magnified by the necessity for taking slopes of CO evolution curves, it is not claimed that this constitutes a proof that the electrochemical mechanism predominates. Further experiments are clearly necessary. ***T. B. King and S. Ramachandran.*** Paper from "The Physical Chemistry of Steelmaking", p. 125-135, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6800 The Desulfurization and Dephosphorization of Carbon-Saturated Iron. The standard free-energy equations which result from such work are a real practical help in that they reveal the limits to which particular reactions can proceed under given sets of conditions. In cases where the reactions proceed sufficiently rapidly to attain equilibrium under plant conditions, the technician can use thermodynamic data to calculate the amount of refining that he will obtain following a change in operating conditions. Desulfurization. Dephosphorization. (1) Data are presented showing that the desulfurization rate of molten carbon-saturated iron by $CaO–SiO_2–Al_2O_3$ slags can be exceedingly high, providing the iron has a high area of slag contact/volume ratio, high-sulfur-concentration gradients, and that the CO gas reaction and the return of sulfur from slag to metal are avoided. (2) Two mechanisms are proposed to account for the removal of phosphorus from hot metal in the presence of high carbon-concentration levels by oxygen blowing. One involves the assumption that the C–O–CO reaction is sluggish, and data are provided in support of this. The second mechanism assumes that the metal immediately surrounding a bubble of oxygen is not in equilibrium with the remainder of the melt. ***C. E. A. Shanahan.*** Paper from "The Physical Chemistry of Steelmaking", p. 136-141, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6801 The Effect of Temperature and Silica on the Dephosphorization of Iron With Lime. To compare the results of these laboratory experiments with the conventional open-hearth practice, curves were selected showing approximate effect of slag lime-silica ratio (basicity % CaO/% SiO_2) and slag FeO on residual phosphorus calculated from Winkler and Chipman (Fig. 8). Some of these curves for 0.010% [P] to 0.015% [P] are shown again in Fig. 9*A*. In Fig. 9*B* curves for the same [P] content were obtained by calculating from Fig. 6. Obviously, in a first approximation the effect of (FeO) in slag and of the basicity is of the same type. In both cases at high values for the ratio % CaO/% SiO_2, the residual phosphorous becomes independent from basicity. In the pure system, however, [P] concentrations higher than about 0.015%, and values for the basicity lower than about 10 cannot be realized. It will be the task of future investigation to bridge this gap between our results in the pure system and the experiments made under plant conditions. ***G. Trömel.*** Paper from "The Physical Chemistry of Steelmaking", p. 142-146, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6802 Some Swedish Experiences of the Importance of Physical Chemistry for the Development of Process Metallurgy. Reduction of iron ore; blast-furnace process; external desulfurization of pig iron; decarburization of solid pig iron; the acid open-hearth process; the basic open-hearth process; deoxidation and tapping. It may perhaps be rather seldom that an idea for a new process is created by the study of the reactions in the laboratory or by purely thermodynamical calculations, but it is, on the other hand, nowadays inconceivable to try to start or to develop a technical method without access to the results from the extensive research work that has been done in this field during the recent decades. ***B. Kalling.*** Paper from "The Physical Chemistry of Steelmaking", p. 149-158,

1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6803 Gas Utilization in the Reduction of Iron Oxides. The purpose of this paper is to summarize calculations of the quantity of reducing gas required to produce a given amount of free iron from its oxide. Gaseous reduction of iron oxide is usually accomplished with mixtures of CO and H_2. The chemical reactions involved have been thoroughly defined to be: $FeO + \frac{CO}{H_2} = Fe + \frac{CO_2}{H_2O}$; $Fe_3O_4 + \frac{CO}{H_2} = 3FeO + \frac{CO_2}{H_2O}$; $3Fe_2O_3 + \frac{CO}{H_2} = 2Fe_3O_4 + \frac{CO_2}{H_2O}$. (1) Optimum reaction temperatures exist for which the utilization of Co—H_2 mixtures in the reduction of iron oxide is a maximum. (2) Maximum gas utilization is accomplished with low reaction temperature of CO-rich mixtures and with high reaction temperature for H_2-rich mixtures. (3) The poorest gas utilization is with a gas mixture of 55% H_2 and 45% CO. Gas utilization is steadily improved by going from this mixture toward 100% CO or 100% H_2. ***G. St. Pierre.*** Paper from "The Physical Chemistry of Steelmaking", p. 159-164, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6804 The Study of Slag-Metal Mixing Efficiency by Models. It has been found that: (1) Gas blowing in the acid layer has little effect on the reaction rate. (2) The efficiency of mixing obtained by gas blowing is much less than that obtained by either pouring the amalgam from a jet into the acid or lip pouring the amalgam into the acid. (3) There appears to be a critical drop height when pouring amalgam into acid beyond which the increased efficiency of mixing is small. (4) In pouring amalgam into acid from a given height, increasing the flow rate increases the reaction rate. (5) The efficiency of mixing obtained by rabbling is low and of the same order as that obtained by simple gas blowing. (6) Bottom blowing from 3 holes produces a mixing efficiency similar to that resulting from the use of a single jet. It appears, however, that a higher total gas flow rate and hence more intense mixing can be tolerated in the former case before "slopping" occurs. ***C. E. A. Shanahan.*** Paper from "The Physical Chemistry of Steelmaking", p. 165-172, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6805 The Chemical Equilibrium in the Basic Bessemer Process. There is no method which permits a quantitative study of the equilibrium between the slag and the metal at the end of the blow in the basic Bessemer converters. In the case of the basic Bessemer heats at the end of the blow, there exists a state of equilibrium. It is possible, with the aid of well-known formulas, to calculate the residual Mn, P, O, and S contents of the steel bath if the slag analysis is known. ***A. M. Decker.*** Paper from "The Physical Chemistry of Steelmaking", p. 173-178, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6806 Solidification of Steel Ingots. Any description of the solidification of steel ingots involves considerable speculation regarding the specific mechanisms involved. The interpretation of the results of studies on this subject is by no means universally accepted. In this paper an attempt has been made to present a description of the solidification process which is consistent with most reliable observations and which has proved useful as a basis for controlling the characteristics of the ingot product. The teeming operation; general solidification processes; ingot solidification; solidification in big-end-up hot-topped molds; effect of gas formation; rimming steels. The description of solidification represents a selection of concepts from published reports and from observations made in a single steel plant in which ingots with a relatively narrow range of compositions are made. There have been other concepts reported which are not consistent with the processes described in this presentation. The interpretation of solidification processes given in this paper appears consistent with available information and, more important, has proved useful in establishing procedures for controlling the behavior and performance of the ingot product. ***M. Tenenbaum.*** Paper from "The Physical Chemistry of Steelmaking", p. 181-193, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6807 Theoretical Study on the Solidification Progress of Ingots of Finite Dimensions. The parabolic law of Lightfoot applies to commercial ingots of finite dimensions only during about the first third ... the solidification process. It is assumed, in agreement with this law, that for finite ingots, the volume of solidified metal (not its thickness) is proportional to the square root of the time elapsed from the end of the pouring operation. ***P. Vallet.*** Paper from "The Physical Chemistry of Steelmaking", p. 194-199, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6808 The Effect of Mold Geometry on Vertical Solidification. In order that the rate of apparent vertical solidification might be calculated easily, several simplifying assumptions were made. These were: (1) That the parabolic law (equation I) was obeyed in the transverse direction. (2) That the advancing solidification front might be treated as a plane and not a zone. (3) That the volume of liquid freezing was proportional to the area of the interface between the solid and the liquid. (4) That no shrinkage took place in going from liquid to solid. (5) That transverse and vertical solidification end simultaneously. ***C. W. Sherman.*** Paper from "The Physical Chemistry of Steelmaking", p. 200-202, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6809 Solidification of Stainless Steel Ingots. Based on the premise that artificial nucleation of solidifying metals is possible, it was observed that the addition of certain types of metallic powders to ferritic types of stainless steels produced a finer as-cast grain size. This was demonstrated on both large and small ingots and various grades. Some success was also obtained with austenitic steels, but results were not consistent. This fact was believed to be associated with the wide freezing range of these alloys. ***D. J. Carney and B. R. Queneau.*** Paper from "The Physical Chemistry of Steelmaking", p. 209-215, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6810 On Segregation in Steel Castings. The classic picture of positive segregation in a steel ingot has the surface of the ingot low in solute, since crystallization initiates at the surface. The central portion of the ingot is rich in solute, and the degree of separation is dependent upon the segregation coefficient of the solute. However, several mechanical, chemical, and thermal factors, in addition to the segregation coefficient, can influence the degree, the direction, and the average distance of solute migration during solidification: (1) rate of solidification, (2) slope of the liquidus, thermal conductivity, and liquid mass diffusivity of the alloy in question, (3) solidification shrinkage, (4) liquid convection, (5) solid thermal contraction, and (6) amount of superheat with which the metal is poured. These factors affect segregation either by modifying mass transfer through the liquid or by causing local flow of solute-rich liquid. ***C. M. Adams, Jr.*** Paper from "The Physical Chemistry of Steelmaking", p. 216-217, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6811 Summary of Needs for Fundamental Research. Molten metal solutions; liquid slags; sulfides; kinetics; solid metals; and new directions for research. ***F. D. Richardson.*** Paper from "The Physical Chemistry of Steelmaking", p. 221-224, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6812 Commentary on the Direction of IRSID'S Research Program in Physical Chemistry. Dr. Kozakevitch gave a short summary of IRSID's history and then outlined briefly the direction of research of IRSID. A summary of the comments is given. ***R. P. Kozakevitch.*** Paper from "The Physical Chemistry of Steelmaking", p. 225, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6813 Physical Chemistry of Steelmaking and Plant Practice. Fundamental steelmaking research is not spectacular and its application is evolutionary, rather than revolutionary, and the future benefits will be in proportion to the rate of research. This rate ultimately is primarily a dollars-and-cents matter, and we have in our control this rate by our appropriations for such research. We can only hope for a bright future if we maintain our fundamental research at a pace fast enough to keep us ahead of the declining quality of raw materials and the rising costs of materials and labor. Fundamental steel-making research sponsored by the steel industry amounts to considerably less than one-half of one cent per ton of ingots produced. We can and must spend more. ***K. L. Fetters.*** Paper from "The Physical Chemistry of Steelmaking", p. 226-228, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6814 Commentary on Research Needs for Process Development. ***K. L. Fetters.*** Paper from "The Physical Chemistry of Steelmaking", p. 229-230, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6815 A Note on Physical Chemistry and the Practice of Steelmaking. The industry is lacking in a clear-cut general theory of the open-hearth process, and when the operator points with pride to the amount of charge ore reduced to raise the yield, in run-off-slag practice, one can neither show him precisely how much this ore reduction costs him in speed and controllability, nor present him with a better method of operation. ***B. M. Larsen.*** Paper from "The Physical Chemistry of Steelmaking", p. 231-232, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6816 Commentary on the Direction of Research for Kinetic Studies. Perhaps some consideration should be given to what some people have referred to as "cross-effects", in other words, the phenomena occurring in sharp gradients such as the temperature gradient between slag and metal, or in the slag in the open-hearth bath. ***L. S. Darken.*** Paper from "The Physical Chemistry of Steelmaking", p. 233, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6817 Kinetic Problems in Steelmaking. A study of the rate of both transport processes and phase-boundary conditions is needed. In some respects, investigations on transport processes are simpler and, therefore, should precede investigations on phase-boundary reactions. For the evaluation of measurements of the rates of transport processes, a better knowledge of diffusion coefficients in both alloys and slags is needed. From a fundamental point of view, investigations on phase-boundary reactions are considered to be most interesting because there are alternative mechanisms between which an experimental decision is needed. By and large, transport-controlled processes are relatively fast, and equilibrium may be approached within a reasonable time, whereas processes controlled by a phase-boundary reaction are slow, and accordingly, equilibrium may not be reached in metallurgical practice. ***C. Wagner.*** Paper from "The Physical Chemistry of Steelmaking", p. 237-251, 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.

6818* Quantitative Investigation of Dendritic Segregation in Some Iron Alloys. Dendritic segregation in iron alloys of the Fe-X and Fe-X-C type has been studied by means of autoradiography and Castaing's micro-probe. The following decreasing order of segregation has been established: As, Mo, Cr, Mn, and Ni. In the absence of carbon segregation is slight or undetectable; thus in the Fe-As alloy, the degree of segregation is thirty times smaller than in the ternary Fe-C-As alloy. The microphotometer curves of the autoradiographs have been calibrated by measuring the optical densities in very exactly marked zones corresponding to the points determined with the micro-analyzer. (*In French.*) Etude quantitative de l'hétérogénéité dendritique dans des alliages de fer. ***J. Philibert and C. De Beaulieu.*** *Revue de Métallurgie*, v. 56, Feb. 1959, p. 171-178.

6819* Research on Influence of Magnesium on the Contraction of Cast Iron. The treatment of cast iron with magnesium bears an influence on these contraction characteristics through a decrease of the eutectic graphite quantity and an increase of the sub-eutectic graphite quantity. The increase of the sub-eutectic graphite quantity is ensured by the increase of the graphitization process activation energy (by decomposition of the cementite; the high contents of silicon and carbon, a high degree of undercooling), a fact which implies equi-axial forms of the graphite nodules. ***L. Sofroni, R. P. Todorov, and G. I. Koshovnik.*** *Revue de Métallurgie (Bucharest)*, v. 3, no. 3, 1958, p. 61-72 + 5 plates.

6820 Reactive Metal Melting Furnace Eliminates Water Cooling Hazard. A new concept in vacuum arc, skull melting may bring down the cost of processing highly reactive metals and eliminate a hazardous condition. It combines a rapid melting cycle with a heavy skull and crucible to handle the heat transferred during melting. Costly and complicated cooling systems are not needed; there is no danger of water-reactive metal explosions. ***M. L. Torti and John L. Ham.*** *Steel*, v. 144, Mar. 9, 1959, p. 64-66.

6821* Study on the Corrosion Mechanism on Refractories Used in a Zebra Roof of a Basic Open-Hearth Furnace. (*In Japanese.*) ***Takeo Ao and Takeji Oyama.*** *Tetsu to Hagané (Journal of the Iron and Steel Institute of Japan)*, v. 45, no. 2, Feb. 1959, p. 93-99.

6822* Magnetic Properties of Spheroidal Graphite Cast Iron. The magnetic properties of spheroidal and flake graphite cast irons of similar composition cast into sand molds of various diameters were measured, and the results obtained were as follows: Under the same degree of graphitization, the maximum induction, the coercive force and the hysteresis loss of spheroidal graphite cast iron were lower than those of flake graphite cast iron, and so the maximum permeability and the residual induction were higher. With increasing degree of graphitization, the maximum permeability increased, whereas the other four quantities decreased. ***Yûki Shirakawa and Takeshi Miyazaki.*** *Tôhoku University, Science Reports of the Research Institutes, Ser. A. Physics, Chemistry, Metallurgy*, v. 10, no. 6, Dec. 1958, p. 399-404.

6823 A Gravimetric Method for Analyzing Blast-Furnace Top Gas. This report describes a primary or direct, continuously sampling, and automatically averaging gravimetric method for analyzing gaseous mixtures of carbon dioxide, carbon monoxide, hydrogen, and (by volume measurement) nitrogen. The gaseous mixture is analyzed by passing it at a controlled and definite rate through a system that permits carbon dioxide and water retained by appropriate absorbents to be determined and the residual-gas volume (essentially nitrogen) to be measured. The accuracy and dependability have been established by comparision with very carefully conducted Orsat analyses. The method was developed for, and has been satisfactorily applied to, the analysis of blast-furnace top gas. It permits relatively attention-free operation, using simple and low-cost materials usually found as basic equipment in the analytical laboratory. ***David J. Kusler.*** *U. S. Bureau of Mines Report of Investigations* 5452, 1959, 12 pp. (Tn21 Un3r Vis.)

See also: **7186** (foundry noise).

METALS—HEAT TREATMENT

6824 Heating Power of Nitrate Baths. Investigation of ways and means of preventing deterioration (impaired heating power) of heat-treating baths of fused salts, and of regenerating them. Relative merits of sodium, potassium, barium, and calcium chlorides, hydroxides, and anhydrous barium nitrate. ***P. Ya. Yakovlev.*** *Henry Brutcher Translation No.* 4396, 7 pp. (From *Metallovedenie i Obrabotka Metallov*, 1958, no. 10, Oct., p. 47-50.) Henry Brutcher, Altadena, Calif.

6825 Bright Quenching of Steel. Set-up for simultaneous quenching and electro-polishing ("bright quenching") of steel parts. Advantages of proposed bright quenching technique:

elimination of surface defects; absence of quench cracks; no need for grinding and polishing; possibility of direct electrodeposition of chromium, nickel, etc., on bright-quenched steel. ***A. K. Beskrovnyi.*** *Henry Brutcher Translation No.* 4398, 4 pp. (From *Metallovedenie i Obrabotka Metallov*, 1958, no. 10, Oct., p. 56-57.) Henry Brutcher, Altadena, Calif.

6826 Quench and Temper Process for the Manufacture of High Strength Tubular Products. Pipe with high strength and a reasonable amount of ductility is being produced by heat treating carbon steel tubular products in modernized continuous quench and temper lines. This article describes one of the latest installations for this purpose and presents data on the mechanical properties obtained. ***H. B. Emerick.*** *Industrial Heating*, v. 26, Feb. 1959, p. 303 + 9 pages.

6827* Effect of Heating Rate in Heat-Treatment. II. Effect of Heating Rate on Properties of Heat-Treated 13% Cr Stainless Steel. (*In Japanese.*) ***Seita Sakui, Tsutomu Mori, and Chiaki Yamamoto.*** *Tetsu to Hagané (Journal of the Iron and Steel Institute of Japan)*, v. 45, no. 2, Feb. 1959, p. 117-122.

6828* Studies on Nickel-Base Heat-Resisting Alloys. II. Effect of Heat-Treatment on Mechanical Properties of Nimonic 80A. (*In Japanese.*) ***Taro Hasegawa.*** *Tetsu to Hagané (Journal of the Iron and Steel Institute of Japan)*, v. 45, no. 2, Feb. 1959, p. 123-127.

6829* Influence of the Annealing Time on the Structure and the Behavior in Transformation of Plain Carbon Steels. (*In German.*) Einfluss der Glündauer auf das Gefüge und das Umwandlungsverhalten unlegierter Stähle. ***Heinz Borchers and Günter Saur.*** *Stahl und Eisen*, v. 79, no. 4, Feb. 19, 1959, p. 210-215.

6830* Sorbitization Reduced Cooling and Air-Hardening of Rails. (*In Polish.*) Sorbitvzacja, zwolnione chłodzenie i normalizowanie szyn. ***Edward Decowski.*** *Wiadomosci Hutnicze*, v. 15, Jan. 1959, p. 18-23.

6831* Inductive Hardening. (*In Polish.*) Hartowanie indukcyjne. ***Marian Chyla.*** *Wiadomosci Hutnicze*, v. 15, Jan. 1959, p. 23-27.

METALS—MECHANICAL AND PHYSICAL PROPERTIES

6832 The Early Stages of Plastic Deformation in Copper. Small plastic strains in the range 1-500 x 10^{-6} were measured with electrical resistance strain gages for high-purity polycrystalline copper tensile specimens. Plastic extension was observed at stresses above about 1000 lb/in^2, and the plastic strain at a given stress was shown to depend on the third power of the grain size. A deformation mechanism is proposed in which the movement of the dislocations produced at small strains is blocked by grain boundaries. This picture predicts the observed grain size dependence and also accounts for the shape of the stress-plastic strain curve and for the magnitude of the plastic strain. Creep was observed in all specimens at stresses slightly above those required for the first observable plastic deformation. The creep rate at constant stress was greater the larger the grain size. ***D. A. Thomas and B. L. Averbach.*** *Acta Metallurgica*, v. 7, Feb. 1959, p. 69-75.

6833 Overshooting in Quenched Aluminum Crystals. Single crystals of 99.8 and 99.993% pure Al which were quenched from annealing treatments at 600 C and strained in tension exhibited marked effects in their deformation process. It was shown in this investigation that the stress axis "overshoots" the [100]-[111] symmetry line and that conjugate slip does not begin until "overshooting" reaches a maximum. Slip lines were found to be long, sharp, and straight with cross-slip in evidence. Stress-strain curves showed low rates of work hardening, and very little asterism was observed in Laue X-ray photograms as compared to those of furnace-cooled crystals, indicating that quenched crystals deform in a much less turbulent manner than do slowly cooled crystals. It is felt that the quenching operation involves the pinning of dislocations by quenched-in vacancies and that the "overshooting" behavior is due to latent hardening of the conjugate slip system as proposed for alpha-brass by Piercy, Cahn, and Cottrell. ***L. E. Tanner and R. Maddin.*** *Acta Metallurgica*, v. 7, Feb. 1959, p. 76-82.

6834 Quenching of Imperfections in Aluminum. The formation and annealing-out of point defects in high purity Al was investigated resistometrically. E_f, the energy of formation of the defects, was found to be 0.79 ± 0.04 eV. The annealing behavior is complex but the temperature variation is well described by an activation energy for the motion of defects, $E_m = 0.52 \pm 0.04$ eV. This is near the activation energy for the clustering of solute atoms at low temperature in Al-rich Al-Cu and Al-Ag aloys. ***W. DeSorbo and D. Turnbull.*** *Acta Metallurgica*, v. 7, Feb. 1959, p. 83-85.

6835 Ultrasonic Investigation of the Plasticity of Metal Crystals. Using tensile tests of metal crystals drawn from the melt (length 11-19 mm, diameter 0.4-0.5 mm) it is shown that the shearing stress necessary for continued translation is decreased markedly by superimposed ultrasonic vibrations. The stress drops immediately after turn-on of the vibration field. After turn-off work-hardening increases rapidly, until finally the rate of hardening arrives at values as measured with crystals that had not been subjected to ultrasonic vibration. The decrease in shearing stress caused by 2W/cm^2 ultrasonic irradiation was found to be about the same order of magnitude (50-100 g/mm^2) for plastic deformation of Al, Cd, and Zn crystals, the temperature being constant. (*In German.*) Plastizitätsuntersuchungen von metallkristallen in Ultraschallfeld. ***F. Blaha and B. Langenecker.*** *Acta Metallurgica*, v. 7, Feb. 1959, p. 93-100.

6836 The Formation of Surface Pits by the Condensation of Vacancies. Small surface pits were observed to form on electropolished surfaces of aluminum single crystals during cooling from elevated temperatures. The amount of cooling required before the pits began to form increased exponentially as the holding temperature decreased. Pits did not form in the vicinity of sub-boundaries or grain boundaries. The width of the pit-free region at the boundary increased with decreasing cooling rates. The formation of pits during cooling is attributed to the condensation of vacancies at the specific location of the free surface. Apparently a definite and constant supersaturation of vacancies is required before condensation begins. ***P. E. Doherty and R. S. Davis.*** *Acta Metallurgica*, v. 7, Feb. 1959, p. 118-123.

6837* Anisotropy of Thermal Conductivity in Single Crystals of Tellurium. The monocrystals of tellurium were formed in a furnace by slowing the cooling from 750 K down to room temperature of a quartz ampoule filled with tellurium several times purified by zone melting. The curve of thermal conductivity revealed much anisotropy in the direction of the crystallographic axes of the single crystal. It decreases with increasing temperature. At low temperatures the electron part of the thermal conductivity must be small. In the interval between, the thermal conductivity can be ascribed to the hot diffusion of phonons. (*In Russian.*) Anizotropiia teploprovodnosti v monokristalle tellura. ***Kh. I. Amirkhanov, G. B. Bagduev, and M. A. Kazhlaev.*** *Akademiia Nauk SSSR, Doklady*, v. 124, no. 3, Jan. 21, 1959, p. 554-556.

6838* A Bibliography of the Electrically Exploded Wire Phenomenon. Original abstracts, from reading of EWP articles, and abstracts taken from Physics Abstracts, Transactions of IRE, Chemical Abstracts, etc., are compiled. The arrangement is by subject group, alphabetical by authors, and inverse chronological for articles by any one author. ***William G. Chace.*** 69 pp. Nov. 1958. Air Force, Cambridge Research Center, Air Research and Development Command, U. S. Air Force, Bedford, Mass. (ZQC 601 Un3.12b Ref.)

6839 Ductility of High-Temperature Strength Alloys as Affected by Structure and Stress State. Develpoment of a dependable method for high-temperature testing of circular-section specimens under static and impact tension; equipment suggested. Changes in microstructure of various high-temperature Ni-Cr alloys under static and impact tension. ***M. V. Rastegaev.*** *Henry Brutcher Translation No.* 4280, 8 pp. (From *Metallovedenie i Obrabotka Metallov*, 1958, no. 7, July, p. 30-35.) Henry Brutcher, Altadena, Calif.

6840 Some Properties of Iron-Copper Alloys Made by Infiltration Process. Study of ways of strengthening phase boundaries and of most suitable aging temperatures and times to give them satisfactory ductility coupled with sufficient mechanical strength. Effect of copper content on mechanical properties. ***I. N. Frantsevich and O. K. Teodorovich.*** *Henry Brutcher Translation No.* 4351, 7 pp. (From *Metallovedenie i Obrabotka Metallov*, 1958, no. 9, Sept., p. 20-23.)

6841 Effect of Melting Practice Upon Properties of Stainless Steel. Experiments on two groups of steel, in part titanium-stabilized: one group melted and poured at final pressures of 2-7 mm Hg; the other melted in air h.f. furnaces. Final furnace pressure needed to give 18-8 steel free from any stabilizing additions, complete resistance to intergranular corrosion and high resistance to corrosion in boiling 50% nitric acid. ***R. S. Belyakov.*** *Henry Brutcher Translation No.* 4363, 12 pp. (From *Primenenie Vakuuma v Metallurgii*, 1958, p. 35-48.) Henry Brutcher, Altadena, Calif.

6842 Effects of High Strains Rates and Rapid Heating on the Tensile Properties of Titanium Alloys. It has been shown by numerous investigators that strength properties tend to increase with increasing strain rate. Most researchers have ignored the effects of rapid heating, however. In order to properly assess the usefulnes of materials under these conditions, special testing techniques must be used. Two organizations, Southern Research Institute and Marquardt Aircraft Company, have developed equipment for high-speed testing after rapid heating and have been evaluating various structural materials. Following generalizations to be drawn: (1) Yield and tensile strength increase with increasing strain rate; this behavior is most pronounced at temperatures above the present service limits of the subject alloys. Retention of strength to higher than normal temperatures can be achieved by testing at very high strain rates. (2) Ductility generally decreases with increasing strain rate. (3) Modulus of elasticity is not significantly affected by strain rate. (4) Holding time has no effect on tensile properties of titanium alloys annealed to a stable condition, except for losses in ductility due to surface oxidation at extremely high temperatures. ***F. R. Schwartzberg.*** *Light Metal Age*, v. 17, Feb. 1959, p. 11-12.

6843* Ductility and Strength of High-Carbon Gray Irons. Composition, microstructure and inoculation effects on ductility and strength of high-carbon (3.5-4.5%) cast irons were evaluated. Irons melted by cupola, induction and blast furnace were included in the study. Some of the cupola and induction-melted irons were inoculated with ferrosilicon or with proprietary inoculating agents. The criterion of ductility was the total elongation (or total strain) reached before fracture. Strain was measured with SR-4 gages cemented to standard tensile specimens. Inoculation of low-manganese (0.3-0.5%) irons produced up to 50% increase in elongation, but the effect of inoculation decreased with increasing manganese content. Ductility was not affected significantly by a wide variation in silicon content and the associated variation in microstructure. For induction-melted and cupola irons, a relatively close relationship was found between carbon equivalent and strength, but the strength of the blast-furnace irons was considerably higher than this relationship would suggest. Increasing the Mn content above 0.5% markedly increased the tensile strength through the associated increase of pearlite. Tensile strength was not affected by inoculation beyond the normal decrease from the increased silicon. There was a reasonably close correlation between hardness and strength for all of the irons. ***E. M. Stein and H. O. McIntire.*** *Modern Castings*, v. 35, Mar. 1959, p. 103-110.

6844* Ductile Iron As-Cast and Annealed Tensile Properties. Data from production heats of ductile iron were studied, principally by means of regression analyses. Some of the conclusions resulting from these studies are presented. Accurate prediction of the tensile properties of this material requires knowledge of both hardness and composition. ***A. H. Rauch, J. B. Peck, and E. M. McCullough.*** *Modern Castings*, v. 35, Mar. 1959, p. 111-116.

6845 The Importance of the Hydrogen Content of Steel Slabs and Its Determination in Sheet Steel. Evidence is provided to show the deleterious effects of hydrogen on the ductility of steel. This appears to be associated with a straining of the steel structure, as judged by metallographic examination and load-elongation curves. Much of the hydrogen found in steel samples of large surface area arises from atmospheric contamination. It is possible to assess this amount for standardized conditions of abrasion, etc., and therefore to calculate the H remaining in a sheet sample from the slab stage. Using the technique referred to in the second conclusion, it is found that the H present in a slab makes only a negligible contribution to the apparent H content of the final sheets. ***C. E. A. Shanahan.*** Paper from "The Physical Chemistry of Steelmaking", p. 203-208. 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6846 Thermoelectric Power and Electron Scattering in Metal Alloys. A phenomenological theory of thermoelectric power in binary, ternary, and more complex noble-metal base alloys is presented, which is based on the well-known thermoelectric power formula of Mott and others. The temperature dependence of certain scattering coefficients leads to information on the variation of scattering cross section with electron kinetic energy; the simple model described appears to be internally consistent and furnishes considerable insight into the nature of electron scattering from point imperfections in metals. It is found from an experimental study of the series of solutes Cr, Mn, Fe, Co, and Ni in copper, that the cross section depends on electron energy in a manner closely resembling that of the Ramsauer-Townsend effect in slow-electron scattering from atoms in the vapor state. ***C. A. Domenicali.*** *Physical Review*, v. 112, ser. 2, no. 6, Dec. 15, 1958, p. 1863-1876.

6847 Correlation of Annihilation Radiation in Oriented Single Metal Crystals. Precision measurements of the two-photon annihilation in crystals of Al and Cu are presented. These show relatively small variation with crystal orientation. ***Stephan Berko and John S. Plaskett.*** *Physical Review*, v. 112, ser. 2, no. 6, Dec. 15, 1958, p. 1877-1887.

6848 Properties of Extruded Alloys—Table VII. Chemistry, and mechanical and physical properties of a number of copper base alloys are tabulated. *Precision Metal Molding*, v. 17, Mar. 1959, p. 36.

6849* Improvement of the Strength of Components Resulting From Hardening and Prestressing of Joints. Mechanical components often subjected to alternating stresses have a service life which is limited by the effects of notches set up by changes in section. The life of such components may be distinctly lengthened by appropriate design and treatment. These should set up residual compressive stresses in the zone affected by these notch effects. The present paper gives, in terms of examples on specimens and then on actual components, rules which can profitably be followed in relation to the component type and the procedure employed. The improvements in life thus secured are considerable. (*In French.*) Amélioration de l'endurance de pièces par durcissement et précontrainte des raccordements. ***J. Pomey, J. P. Georges, and A. Royez.*** *Revue de Métallurgie*, v. 56, Jan. 1959, p. 1-10.

6850* Fatigue-Micromachine for Tension-Compression Tests at 92,000 Cycles per Second. The described micromachine consists of a piezoelectric exciter which vibrates in half-waves and which brings about in a sample, by means of mechanical amplifiers, an alternate stress susceptible to cause its rupture. Only samples of alloys with low damping can be broken by this micromachine (alloys of aluminum, magnesium, titanium). As an example, a Wöhler curve of a Duralumin specimen has been established. The appearance of ruptures at about 3.10^9 alternations shows up that even at this value the endurance limit—if there is one—has not yet been attained. (*In French.*) Micromachine de fatigue en traction-compression à 92,000 alternances par seconde. ***F. Girard and G. Vidal.*** *Revue de Métallurgie*, v. 56, Jan. 1959, p. 25-39.

6851* Creep of Hard Pre-Stressed Steels in the Temperature Range Designated "Normal". Influence of Variations in Stress and of Temperature. The influence on creep of stress variations in alloys at normal temperature is not highly sensitive to the length of the period, provided this is short. The creep approaches that of the creep under higher stress which is held constant without, however, reaching it. The creep of hard steels varies greatly with the temperature, but the influence of this

factor differs amongst the range of hard steels. (*In French.*) Le fluage des aciers durs de précontrainte dans le domaine des températures dites ordinaires. Influence des variations de tension et influence de la température. ***Robert De Strycker.*** *Revue de Métallurgie*, v. 56, Jan. 1959, p. 49-54.

6852* The Problem of Ductility of Beryllium for Reactors. The lack of ductility of beryllium causes fabrication and joining difficulties, and results in inadequate properties for reactor use. Evidence suggests the embrittlement of the metal by interstitial impurity atoms. Increase of ductility might be obtained by: (1) the fabrication control of grain structure and orientation, or (2) improved metal purity. The latter should also permit case of joining. (*In French.*) Le problème de la ductilité du béryllium destiné aux réacteurs. ***G. C. Ellis.*** *Revue de Métallurgie*, v. 56, Jan. 1959, p. 75-82.

6853* Contribution to the Physical Investigation of Fatigue Damage. In the author's opinion, the factor which can be used to characterize fatigue damage in the most direct manner is the position after damage of a definite point on the Wöhler curve. The author has thus determined the effect of damage on the value (E) of the stress for which one finds 50% failures before 3 million reversals. The second factor concerns the low-temperature mechanical properties of the metal. The author hoped to obtain interesting information from tensile tests carried out at 90 K on polished (and notched) specimens subjected to various degrees of damage. At this temperature it might be hoped that fatigued specimens presenting microfissures would break at a low elongation and that the breaking stress would vary with the degree of damage in a significant manner. (*In French.*) Contribution à l'étude physique du dommage par fatigue. ***M. Weisz.*** *Revue de Métallurgie*, v. 56, Jan. 1959, p. 83-103.

6854* Influence of Surface Condition on Some Properties of Uranium. The influence of the physico-chemical surface condition on the reactivity of uranium with oxygen has been studied by various methods, particularly electron microscopy and diffraction and ionic bombardment. It has thus been possible to ascertain the nature of the oxides formed and their texture. The part played by the surface structure of the uranium in the mechanism of the diffusion of certain metals has also been demonstrated. (*In French.*) Influence de l'état de surface sur quèlques propriétés de l'uranium. ***C. Sella and J. J. Trillat.*** *Revue de Métallurgie*, v. 56, Feb. 1959, p. 105-121.

6855 Effects of Neutron Irradiation on Mechanical Properties of Ferritic Steels and Irons. This report summarizes the data obtained to date in an investigation of the effect of neutron irradiation on the mechanical properties of ferritic steels and irons. Part of the study is concerned with the effect of the two main metallurgical variables (i.e., composition, and microstructure as controlled by heat treatment) on the magnitude of the radiation-induced change in properties. The paper also reports the effect of progressively greater integrated fluxes on the changes in properties and some data on annealing behavior under post-irradiation heating. ***L. P. Trudeau.*** *Second International Conference on the Peaceful Uses of Atomic Energy, Geneva, Sept. 1958, Paper P/190*, 11 pp. (QC770 In8a2 Contin.)

6856 How to Increase High Temperature Reliability of A-286 Fasteners. Study indicates that six design and fabrication techniques can greatly extend their life. Lack of proper procedures in present practices has jeopardized future use of the material. *Steel*, v. 144, Mar. 16, 1959, p. 114 + 3 pages.

6857* Relation Between the Dent Size, Density in Fundamental Shot-Peening and the Fatigue Strength. (*In Japanese.*) ***Michira Uchiyama and Kazunori Kamishohara.*** *Tetsu to Hagané (Journal of the Iron and Steel Institute of Japan)*, v. 45, no. 2, Feb. 1959, p. 105-110.

6858* Effect of Shot-Peening on Fatigue Strength of Metals. I. Effects on Polished State. To investigate the effect of shot-peening on the fatigue characteristics of metals, preliminary fatigue tests were carried out by the rotary bending method with polished and shot-peened materials of pure iron, Si-Mn steel, 17 S Al alloy and 4/6 brass, and the results obtained were as follows: (1) The endurance life of all the materials tested was prolonged by several times, and the fatigue strength at 10^7 cycles was increased by 3 ~ 13% by shot-peening; (2) The fatigue limit was not varied or only slightly increased by repolishing to remove the surface roughness due to shot-peening; (3) The fatigue limit was reduced by annealing at high temperatures in order to soften the surface layer hardened by shot-peening, and this tendency was the stronger the higher the increase in the tensile strength. ***Sakae Takeuchi and Tsuneo Homma.*** *Tôhoku University, Science Reports of the Research Institutes, Ser. A. Physics, Chemistry, Metallurgy*, v. 10, no. 6, Dec. 1958, p. 426-434.

6859 Tensile Properties of Aircraft-Structural Metals at Various Rates of Loading After Rapid Heating. Specimens were heated to the test temperatures within ten sec, held for periods of time ranging from 10 sec to 1800 sec, and loaded at strain rates from 0.00005 to 1.0 in./in./sec. Chro-Mow tool steel, Thermold-J tool steel, Peerless-56 tool steel, and AM-350 precipitation-hardening stainless steel—and 6Al-4V titanium alloy were fully evaluated, the steels being tested at temperatures up to 1200 F and the titanium alloy up to 1000 F. ***Haywood E. Dedman, Edmund J. Wheelahan, and J. Robert Kattus.*** *U. S. Air Force, Wright Air Development Center, WADC Technical Report* 58-440, Nov. 1958, 197 pp. (TL507 Un3.18w Vis.)

6860 Investigation of the Properties of Tantalum and Its Alloys. A survey of literature pertaining to tantalum and tantalum alloys is reported in narrative style with references to published data. A bibliography of available publications is included. Emphasis was placed on subjects pertinent to the research being conducted on this project with a more general coverage of other subjects. ***William D. Klopp, Fred R. Schwartzberg, Frank C. Holden, Chester T. Sims, H. Russell Ogden, and Robert I. Jaffee.*** *U. S. Air Force, Wright Air Development Center, WADC Technical Report* 58-525, Nov. 1958, 78 pp. (TL507 Un3.18w Vis.)

6861 Grain Size Effects on Fatigue and Their Relationship to Notch Geometry, Stress Gradient and Size of Specimens. Study was conducted of a 2.5 Al-magnesium alloy at room temperature. Three different grain sizes and seven different notch sizes were used in this investigation. ***F. H. Vitovec.*** *U. S. Air Force, Wright Air Development Center, WADC Technical Report* 58-539, Dec. 1958, 32 pp. (TL507 Un3.18w Vis.)

6862 Tensile Properties of Molybdenum and Tungsten From 2500° to 3700°F. Specimens of wrought sintered tungsten, arc-cast unalloyed Mo, and a Mo alloy containing 0.5% Ti were fabricated from ½-inch-diameter rolled or swaged bars. Tensile test equipment described herein was used to evaluate the specimens both in the as-received condition and after a 30-minute recrystallization anneal at 3800 F. Two as-received tests were also made on an experimental Mo alloy containing 0.46% Ti and 0.07% Zr. Results show that W was considerably stronger than the Mo specimens over the temperature range specified. Differences in the fracture ductility were also observed. ***Robert W. Hall and Paul F. Sikora.*** *U. S. National Aeronautics and Space Administration, NASA Memorandum* 3-9-59E, Feb. 1959, 30 pp. (TL782 Un3rm Vis.)

See also: **6124** (high-temperature properties of aircraft metals); **6556** (properties of semiconductors); **6884** (slip in iron); **6892** (thermochemical properties); **6900** (properties of metals at low temperatures); **6902** (fatigue cracking of steel).

METALS—MECHANICAL WORKING

6863 Electron Beam Machining. Almost daily, new uses are being found for metalworking's hottest new tool—the electron beam. Already reported are welding and melting; rumored is metal deposition. And now: machining. West Germany's Carl Zeiss has come up with electron beam equipment capable of cutting a clean-edged slot or hole through the toughest materials to a slot width of 0.0015 in. or even less. With tape control, it cuts extremely accurate, intricate profiles. And there's no cutting tool, therefore no tool wear. The cutting unit operates on the same principle as the electron beam welder, but it

focuses the beam into a much smaller spot. Too, it raises the energy concentration to a level that vaporizes the work material. ***Richard T. Berg.*** *American Machinist*, v. 103, Mar. 9, 1959, p. 115-116.

6864 Forging Practice and Quality of Steel for Steam-Turbine and Turbogenerator Rotors. Production practices for fully-forged steam-turbine and turbogenerator rotors weighing up to 150 tons. Heat treating schedule for rotor of Ni-Cr-Mo steel having a body diam. of 1090 mm. (43"). Cold trepanning: advantages and drawbacks. Analysis of most common defects found in rotor steels before and after forging. ***N. V. Tikhomirov.*** *Henry Brutcher Tranlsation No.* 4186, 11 pp. (From *Metallovedenie i Obrabotka Metallov*, no. 4, Apr. 1958, p. 39-43.) Henry Brutcher, Altadena, Calif.

6865* Stainless Steel in the Sheet Metal Shop. II. Fabrication. Fabricating operations for the most popular types of stainless. Covers shearing, blanking, perforating, bending, welding, and finishing. ***Richard E. Paret.*** *Heating & Air Conditioning Contractor*, v. 50, no. 6, Mar. 1959, p. 70-75.

6866* An Optical Technique for Continuous Measurement of the Width of Narrow Hot Rolled Strip. Experimental instrument is described. Works trials indicated an accuracy of ± 0.005 in. with a response speed of 0.1 sec, irrespective of considerable transverse shake of the moving strip. Air purging arrangements enable the instrument to operate in the face of continual heavy air pollution by scale dust from the strip. ***C. Burns and J. W. Stevens.*** *Instrument Practice*, v. 13, Mar. 1959, p. 277-282.

6867* Shot Peening in Relation to Gear Tooth Scoring. Although used primarily for increasing fatigue strength, shot peening can be used to avoid other types of failure. ***J. C. Straub.*** *Lubrication Engineering*, v. 15, Mar. 1959, p. 106 + 4 pages.

6868 Fabrication of Refractory Metals. Discusses the forming, machining, grinding and welding of molybdenum, niobium, tantalum, rhenium and tungsten. ***W. L. Bruckart.*** *Metal Industry*, v. 94, Feb. 13, 1959, p. 123 + 3 pages.

6869* Elastic Deformation of Stable Cylindrical Shafts During Turning. Mathematical analysis. ***P. G. Fornasini.*** *Microtecnic* (English Edition), v. 12, no. 6, Dec. 1958, p. 323-330.

6870* The Study of Chip Formation: Problem of Plastic Deformation as Deduced From the Theory of Discontinuous Chip Removal. ***Giuseppe Carro-Cao.*** *Microtecnic* (English Edition), v. 12, no. 6, Dec. 1958, p. 331-337.

6871 Industry Putting Increased Emphasis on HEF Processes. The missile industry is giving increasing attention to the possibilities of high-energy forming (HEF) of metals—a process that can be expected to achieve tremendous growth. But the physical and metallurgical problems still remain largely unanswered with techniques being debated. Until the need for using high-strength alloys in present-day vehicles arose, there was no economic justification for using explosives. In recent years, however, missiles have refocussed attention on explosive forming. ***Frank G. McGuire.*** *Missiles and Rockets*, v. 5, no. 14, Apr. 6, 1959, p. 28-29.

6872* Shortcut to Sheet. Molten aluminum is cast directly into quarter-inch-thick reroll sheet. Ingot and scrap are fed into melting hearth; molten metal flows into holding hearth, then to tap-out box. Metal then flows horizontally through launder, up through spreader which distributes it across width of casting rolls. As metal solidifies rapidly just below "bite" of water-cooled rolls, the solid sheet is forced upward, loops down through leveller and edge miller to coiler. ***F. L. Church.*** *Modern Metals*, v. 15, no. 2, Mar. 1959, p. 30 + 4 pages.

6873 Performance of Metal-Cutting Tools. Interrelationships between chip formation, tool life, and surface finish. ***R. Tourret.*** 184 pp. 1958. Butterworths Scientific Publications, London. (TJ1186 T64p.)

6874 Metal Cutting With Ceramic Tools. Systematic investigations of lengthy experiments in machining with ceramic tools; accomplishments of Russian and Western science in this field. Analysis of physical-mechanical properties of ceramic tool materials, cutting forces, temperatures, tool wear, surface finish. Recommendations in selecting tool geometry and cutting rates. (*In Russian.*) Rezaniye metallov keramicheskim instrumentom. ***A. M. Vul'f.*** 182 pp. 1958. State Scientific-Technical Publishing House of Machine-Construction Literature, Moscow-Leningrad. (TJ1230 V97r)

6875 Cutting With Ceramic Tools. A collection of 18 papers on the experience of various plants and research organizations in tool design, geometry, life, sharpening, and cutting rates. In one plant ceramic tools are being used successfully to cut steel discs at 3720 sfm with 3.5 mm depth of cut and 0.3 mm/rev feed. Two papers discuss use of ceramics for other than cutting tools and one paper is devoted to the manufacturing technology of ceramic materials. (*In Russian.*) Rezaniye Mineralokeramicheskimi Instrumentami. ***S. B. Futorian and A. E. Gel'fand, editors.*** 208 pp. 1958. Publishing House of the Defense Industry, Moscow. (TJ1186 N22r)

6876 Experience With Ceramic Tools at the Plant. Design and use of milling cutters having 12 ceramic tips set at different radii and at graduated distances from the table. (*In Russian.*) Opyt primeneniia mineralokeramicheskikh instrumentov na zavode. ***Iu. D. Ligskiĭ.*** Paper from "Rezaniye Mineralokeramicheskimi Instrumentami". p. 148-172, 1958. Publishing House of the Defense Industry, Moscow. (TJ1186 N22r)

6877 Do It Yourself: Explosive Cutting. New DuPont explosive handles like limp linoleum. It is used to cut metals up to one inch thick. Adhesive backed strip of explosive is pressed against metal along configuration to be cut, then the prepared part is placed on the hard ground or in a pool of water and detonated electrically. Edges of the cut are slightly ragged but technique is quick, easy, and reasonably safe. *Steel*, v. 144, Mar. 23, 1959, p. 104-105.

6878* Study on the Rolling of Metals and Alloys With Sendzimir Reversing Cold Strip Mill. I. Pattern of Waves Appearing on the Metal Foils. In the rolling of metal foils with a Sendzimir reversing cold strip mill of the ZR 32-4 type, regularly spaced waves inclining to the rolling direction were sometimes observed on the foil surface. The occurrence of the waves was dependent on the front tension, but not essentially on the back tension. These waves were thought to be a kind of the center buckling of strip, but not to be the stretcher strains produced in aluminum alloys and mild steels, nor to be the herring-bone markings observed in copper alloys. ***Eihachirô Tanaka and Tadatsugu Yoshiki.*** *Tôhoku University, Science Reports of the Research Institutes, Ser. A, Physics, Chemistry, Metallurgy*, v. 10, no. 6, Dec. 1958, p. 405-413.

6879* Some Information on Diamond Dies. Drawing capacity; wear; maintenance. ***W. Lier.*** *Wire Industry*, v. 26, Feb. 1959, p. 147-148.

6880* Cross Roll and Roller Straightening Machines for Round Bars, Tubes and Sections. I. Fundamentals and method of operation; multi-roller straightening machines; principles of the two-roll machine. ***-Ing. H. Makelt.*** *Wire Industry*, v. 26, Feb. 1959, p. 153 + 3 pages.

6881* Cross Roll and Roller Straightening Machines for Round Bars, Tubes and Sections. II. Analysis of motions and forces. Design of equipment. ***H. Makelt.*** *Wire Industry*, v. 26, Mar. 1959, p. 273 + 5 pages.

See also: **6723** (shrink-fit stresses); **6912** (fabrication of carbide-tipped cutting tools); **6927** (fabrication of tungsten); **7129** (tooling in plastics).

METALS—METALLOGRAPHY, TRANSFORMATIONS, AND STRUCTURES

6882 Pseudo-Martensitic Transformation in Zirconium Hydride. Metallographic examination of a series of Zr-H alloys reveals the existence of two different hydride phases. The hydride corresponding to full saturation of the metal with hydrogen (1 atm. pressure) has a tetragonal lattice ($c/a<1$),

as shown by various authors. The metallographic structure of this phase has certain particularities which indicate that its formation depends on a pseudo-martensitic transformation of a cubic phase. (*In French.*) Transformation pseudo-martensitique dans l'hydrure de zirconium. ***D. Whitwham, Melle A. Huber, and J. Hérenguel.*** *Acta Metallurgica*, v. 7, Feb. 1959, p. 65-68.

6883 Self and Interdiffusion in Aluminum-Zinc Alloys. The self-diffusion rates of radioactive Zn^{65} and the interdiffusion rates were determined in f.c.c. Al-Zn alloys. The self-diffusivity of zinc D_{Zn} increases as the zinc content is increased, while the thermodynamic driving force decreases with increasing zinc content until a minimum is reached at about 38 at. % Zn, just above the miscibility gap. ***J. E. Hilliard, B. L. Averbach, and Morris Cohen.*** *Acta Metallurgica*, v. 7, Feb. 1959, p. 86-92.

6884 The Metallography of Deformed Iron. The slip lines produced on the surface of polycrystalline iron, after deformation of 20-30%, have been examined with the aid of carbon replicas and the electron microscope. Different types of slip traces have been observed but the most comomn was that of diffuse wavy bands. From the attenuation of an etch structure it has been possible to estimate the total slip displacement in the slip band and the band width. ***D. G. Brandon and J. Nutting.*** *Acta Metallurgica*, v. 7, Feb. 1959, p. 101-110.

6885 Study of Precipitation in Several Nickel-Base Alloys. The investigation of the pre-precipitation phenomenon in the alloy Ni-80%-Cr 20%, hardened with Al and Ti, led to the study of precipitation in the following nickel-base alloys: Ni-Al, Ni-Al-Ti, Ni-Cu-Al, Ni-Si, Ni-Cu-Si, and Ni-Mo-Si. All these alloys precipitate an ordered face-centred-cubic phase in a f.c.c. matrix. Two classes of alloys exist: those in which the precipitates form platelets and those which form cubic particles. The second category appears when the concentration causes a difference in parameters between the matrix and the precipitate of the order of 0.01 Å. (*In French.*) Contribution a l'etude de la precipitation dans un groupe d'alliages a base de nickel. ***J. Manenc.*** *Acta Metallurgica*, v. 7, Feb. 1959, p. 124-130.

6886 Metallography of Uranium. Summarizes the current state of the art of uranium metallography. Describes the various allotropic transformations and the crystallography of these phases. Common heat-treating temperatures and recrystallization temperatures are listed. Surveys nonmetallic inclusions. Typical photomicrographs illustrating these inclusions are shown, and some of the current thinking concerning the UO and UN group is discussed briefly. ***R. F. Dickerson.*** *American Society for Metals, Transactions*, v. 52, *Preprint No.* 120, June 4, 1958, 22 pp. (TS300 Am35t Vis.)

6887 Effect of Ultrasonic Vibrations on Diffusion in Steels and Alloys at Elevated Temperatures. Effect of ultrasonic waves on rate of pack carburizing of Armco iron and an alloy steel (0.12% C, 0.75 Cr, 3 Ni), and on the aging of Nimonic. Set-up developed for transmission from a magnetostrictive-type of transducer to specimens held in furnace at high temperatures. ***G. I. Pogodin-Alekseev.*** *Henry Brutcher Translation No.* 4247, 6 pp. (From *Metallovedenie i Obrabotka Metallov*, no. 6, June 1958, p. 14-17.) Henry Brutcher, Altadena, Calif.

6888 Effect of Nickel on Transformations Occurring in Aluminum-Copper Alloys at Elevated Temperatures. Studies during prolonged aging at 300 C (570 F) after quenches from above 500 C (930 F). ***A. Z. Zhmudskii and P. A. Maksimyuk.*** *Henry Brutcher Translation No.* 4319, 7 pp. (From *Metallovedenie i Obrabotka Metallov*, no. 8, Aug. 1958, p. 34-37.) Henry Brutcher, Altadena, Calif.

6889 The Diffusion of Oxygen in Alpha and Beta Zircaloy 2 and Zircaloy 3 at High Temperatures. Diffusion rates were determined in the range 1000-1500 C. Spot checks of the diffusion of oxygen in alpha and beta Zircaloy 3 to 1100 and 1400 C show that the rates are in close agreement with those for oxygen in Zircaloy 2. The diffusion coefficients for oxygen in beta Zircaloy 2 and Zircaloy 3 are about 10 times greater than those for nitrogen in high-purity beta zirconium. ***M. W. Mallett, W. M. Albrecht, and P. R. Wilson.*** *Electrochemical Society, Journal*, v. 106, Mar. 1959, p. 181-184.

6890 Diffusion in Metals. A fundamental review of diffusion in solid alloys and pure metals and in liquids; also discusses diffusion of interstitials and diffusion along surfaces. ***Paul Shewmon.*** *Industrial and Engineering Chemistry*, v. 51, Mar. 1959, pt. II, p. 402-405.

6891 Binary and Ternary Alloys of Tin With the Elements of Groups II_B, III_B and V_B of the Periodic Table. To examine the effect of third metals on the simple hexagonal Sn-rich intermediate phases of the βSn-Cd type, Sn-rich alloys of the systems Sn-Cd-Zn, Sn-Cd-Tl, Sn-Cd-Bi, and Sn-In-Sb were examined by metallographic, X-ray, and electrical resistance methods. Experiments on the binary system S Sn-Cd, Sn-Zn, Sn-Tl, and Sn-In were also carried out to clarify discrepancies in the literature. ***H. W. Rayson, C. W. Goulding, and G. V. Raynor.*** *Metallurgia*, v. 59, Mar. 1959, p. 125-130.

6892 Metallurgical Thermochemistry. This third edition reflects the ever growing interest in and importance of the practical application of chemical thermodynamics. The extensive tables of thermochemical data have been completely brought up to date and the book has been revised in the light of recent researches and experimental work. Deals with heat of formation, entropy and entropy changes, transformation, fusion and evaporation, experimental methods, equilibria with a gaseous phase, colorimetric methods, solutions, and thermodynamic functions. ***O. Kubaschewski and E. LL. Evans.*** 3rd Rev. Ed. 426 p. 1958. Pergamon Press, New York. (QD511 K95m3)

6893* A Kinetic Study of Irradiation Induced Phase Changes in Uranium-9 w/o Molybdenum Alloy. Uranium-Mo alloys transform from the stable to the metastable phase due to neutron bombardment. This phenomenon is explained on the basis of the smoothing out of concentration gradients due to the action of "displacement spikes" or "thermal pulses" generated within the sample. A kinetic study of this reaction in U-9 w/o Mo alloy specimens was performed in which the phase reversal was followed by electrical resistivity measurements on the samples while they were being irradiated and held at low temperatures in-pile. The special facility which was constructed to perform this work, as well as the results of the first in-pile experiment, are described. ***M. L. Bleiberg.*** *Nuclear Science and Engineering*, v. 5, Feb. 1959, p. 78-87.

6894 The Positions of Dislocations in Arrays. Equilibrium positions of dislocations in a number of types of array found numerically. Arrays considered are: (1) that generated by a dislocation source which is between two locked dislocations, (2) a dislocation pile-up against a locked dislocation which is not on the slip-plane, (3) a group of positive dislocations attracted to a group of negative dislocations but prevented from coalescing by locked dislocations, and (4) a group of positive dislocations attracted by a group of negative dislocations on a parallel slip plane. ***A. K. Head.*** *Philosophical Magazine*, v. 4, ser. 8, Mar. 1959, p. 295-302.

6895 The Preparation of Smooth Single Crystal Surfaces of Silver by an Evaporation Technique. Electron diffraction study of the growth of evaporated silver layers on cleaved mica surfaces, with the substrate at various temperatures during the deposition. Good orientation (epitaxy) occurs over a wide range of temperatures, but the nature of the orientation depends upon both the substrate temperature and the film thickness. ***D. W. Pashley.*** *Philosophical Magazine*, v. 4, ser. 8, Mar. 1959, p. 316-323 + 2 plates.

6896 The Observation of Dislocations in Thin Single Crystal Films of Gold Prepared by Evaporation. An evaporation technique was developed to allow thin (approx. 200 Å thick) detached single crystal films of gold to be prepared. Dislocation lines are observed in these films with a density of 10^{10}-10^{11}/cm^2. A prominent feature of the movement is the occurrence of wide ribbons of stacking faults due to the splitting of a dislocation into two partial dislocations. Cross-slip is observed. Annealing of the films produced some regular arrays of dislocations, including hexagonal networks and arrays at low angle boundaries. ***D. W. Pashley.*** *Philosophical Magazine*, v. 4, ser. 8, Mar. 1959, p. 324-335 + 2 plates.

6897 Activity of Carbon in Liquid Iron-Carbon Solutions. The early physical chemistry of steelmaking was content with applying the law of mass action in its original form to solutes in liquid iron. Much was written then on how to express the

concentration of carbon. Was carbon dissolved as atoms or as molecules such as Fe_3C? Precarious phase-diagram and thermal data could not help to settle the issue. As metallurgical chemistry was gradually approached from a more thermodynamical point of view, nonideal solutions gained recognition, and the necessity to establish activity-concentration relationships was realized. The nature of the solution, now known to be interstitial in the case of carbon, could be ignored for that purpose. ***A. Rist and J. Chipman.*** Paper from "The Physical Chemistry of Steelmaking", p. 3-12. 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6898 Activity of Carbon in Molten Fe-C Alloys at High Carbon Content—A Progress Report. Because of the recent interest in the activity of carbon in molten high-carbon Fe-C alloys, it was considered to be of interest to this Conference to review the current research on this subject being conducted at IRSID. The work is aimed at measuring the activity of carbon at concentrations where difficulties are encountered with carbon deposition when using gas mixtures containing CO and CO_2 alone. ***J. A. Cordier and P. P. Kozakevitch.*** Paper from "The Physical Chemistry of Steelmaking", p. 13-17. 1958. The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York. (TN730 C76p Over.)

6899* Oak Ridge Reports on Graphitization in H-P Steam Lines. Reviews progress of graphitization in carbon-moly steel components of the Gaseous Diffusion Plant power station. ***C. H. Mahoney and W. S. Dritt.*** *Power Engineering*, v. 63, Mar. 1959, p. 68-69.

6900 Progress in Metal Physics. Reviews the following fields: equilibrium, diffusion, and imperfections in semiconductors; the physical metallurgy of titanium alloys; thermodynamics and kinetics of martensitic transformations; the stored energy of cold work; and the properties of metals at low temperatures. ***Bruce Chalmers and R. King, editors.*** v. VII. 408 pp. 1958. Pergamon Press, New York. (TA459 C35p Vis.)

6901 The Physical Metallurgy of Titanium Alloys. Shows that the alloying nature of Ti is such that it will form extensive solid-solution alloys with all of the transition elements and, also, with those nontransitional elements of relatively low valence which make a good atomic size fit with Ti and which do not boil at temperatures appreciably below the melting point of Ti. In addition, the potentialities for forming interstitial solid solutions with H, O, N, and C are good because of titanium's transitional nature, and the relative diameter ratios are favorable. ***R. I. Jaffee.*** Paper from "Progress in Metal Physics", v. VII, p. 65-163 + 5 plates. 1958. Pergamon Press, New York. (TA459 C35p Vis.)

6902* The Relation Between the Distance of an Inclusion From the Surface and Its Effect on Fatigue Cracking. In a steel affected by inclusions, fatigue cracks appear to start from inclusions located just below the surface or even at the surface itself. To explain this fact, a photo-elastic investigation was made on the influence of the distance between a circular hole and the edge on the stress distribution round the hole: within a certain region one does in fact find stresses of a higher level than with a circular notch running into the surface. *(In French.)* Sur la relation entre la distance d'une inclusion à la surface et l'influence de cette inclusion sur la fissuration par fatigue. ***H. De Leiris and E. Frappier.*** *Revue de Métallurgie*, v. 56, Jan. 1959, p. 11-24.

6903* Physico-Chemical Reactions Occurring in Steels Containing 18 Per Cent Chromium and 2, 4 and 6 Per Cent Nickel. From the structural point of view the steels which contain 18% Cr and from 2 to 6% Ni lie between the Cr containing ferritic stainless steels and the austenitic steels of the 18/8 type. They lend themselves particularly well to the study of the tempering of martensite (from 500 to 1,000 deg.C.), of the formation of the δ phase (from 700 to 1,300 C) by magnetic, dilatometric and micrographic methods. The extent of diffusion of Cr and Ni in Fe, which is smaller in austenite than in ferrite and which is imperceptible at 500 C, in actual fact governs the development of the structure. (*In French.*) Réactions physico-chimiques se produisant dans les aciers à 18% de chrome et 2, 4 ou 6% de nickel. ***Paul Bastien and Alain Sulmont.*** *Revue de Métallurgie*, v. 56, Jan. 1959, p. 40-48.

6904* Application of an Electrolytic Plug in Electron Micrography. The electrolytic plug developed for local polishing of metallographic specimens and of samples offers numerous advantages over the cell device for obtaining and detaching certain replicas used in electron microscopy. Several examples are given to illustrate the results given by this new method. (*In French.*) Application du tampon électrolytique à la micrographie électronique. ***Pierre A. Jacquet and E. Mencarelli.*** *Revue de Métallurgie*, v. 56, Feb. 1959, p. 129-142.

6905* Study on the Evaluation of the Structure Formed in Quenched and Tempered High Speed Steel. Perceptibility of the grain boundaries in high speed steels as dependent on the intensity of the etch, the etching medium, tempering temperature and number of tempering treatments; possibility of estimating the tempered condition; effect of the hardening temperature on the structure of high speed steels in the tempered condition. (*In German.*) Zur Beurteilung des Gefügebildes von gehärtetem und angelassenem Schnellarbeitsstahl. ***Ernst Kunze.*** *Stahl und Eisen*, v. 79, no. 3, Feb. 5, 1959, p. 145-148.

6906* Study on the Graphitization of High-Carbon Steel. II. Effect of Aluminum and Nitrogen on the Graphitization of High-Carbon Steel. Pt. I. (*In Japanese.*) ***Naomichi Yamanaka and Kunio Kunio Kusaka.*** *Tetsu to Hagané (Journal of the Iron and Steel Institute of Japan)*, v. 45, no. 2, Feb. 1959, p. 110-117.

6907* Sub-Zero Treatment of Quenched Steel. I. On the Stabilization of Retained Austenite. As a fundamental study of sub zero treatment of steel, the effects of quenching temperature, room temperature aging and tempering on the stabilization of retained austenite were examined. The stabilization of retained austenite was promoted by aging, because the martensite of sub zero treatment of steel, the effects of quenching temperatransformation rate due to subsequent sub zero cooling was increased by the increase in aging, and moreover, when aging increased, the martensite transformation rate passed through a maximum. The martensite transformation due to subsequent sub zero cooling gave rise to the burst transformation when aging increased to a certain degree. The remarkable increase in the stabilization was caused by the increase in the amount of prior martensite, though the stabilization occurred without prior martensite. It was suggested that the stabilization of austenite was caused by a mechanism similar to age-hardening. ***Yûnoshin Imai and Masao Izumiyama.*** *Tôhoku University, Science Reports of the Research Institutes, Ser. A. Physics, Chemistry, Metallurgy*, v. 10, no. 6, Dec. 1958, p. 414-425.

See also: **6235** (diffusion of Be in BeO); **7110** (structure conversion in metal alloys).

METALS—POWDER

6908* A New Method for Preparation of Tubes and Rods of Refractory Metals and Their Compounds. Carbides, nitrides, borides, silicides, and sulfides were plasticized, extruded, and sintered. (*In Ukrainian.*) Novyi sposib vygotovlennia trub i sterzhniv iz poroshkiv tugoplavkykh metaliv ta ikh spoluk. ***H. V. Samsonov and P. S. Kyslyi.*** *Akademiia Nauk Ukrains'koi RSR, Dopovidi*, 1959, no. 1, p. 46-48.

6909 Powdered Magnets. Properties of magnet materials. ***George Sideris.*** *Electronics*, v. 32, no. 9, Feb. 27, 1959, p. 69.

6910 Iron Powders for Cores. Properties of representative compressed iron powder cores; effect of sintering on iron powder; typical properties of nickel-iron cores. *Electronics*, v. 32, no. 11, Mar. 13, 1959, p. 141.

6911 Metal Powder Association, Proceedings Fourteenth Annual Meeting. Sixteen papers delivered at Philadelphia, Pa., April 21-23, 1958. v. 14, 125 pp. 1958. Metal Powder Association, New York. (TN695 M56p Vis.)

6912 New Powder Metallurgy Applications in the Metal Cutting Field. Describes manufacture and advantages of cutting tools consisting of carbide tips permanently "locked in" a powder-metal holder. ***Horace Frommelt.*** *Metal Powder Association, Proceedings*, v. 14, 1958, p. 5-8. (TN695 M56p Vis.)

6913 Mechanical Filter Transducer Wire and Resonator Disks by Powder Metallurgy. Sintered compacts are rolled and drawn into wire. The transducer wire produced in this manner is more uniform and has a lower Q value than that made from the induction melted material. Resonator disks are pressed, and, after an oxide reduction treatment in hydrogen, the disks are loaded in an Inconel boat and sintered for 7½ hours at 2200 F in forming gas. Sintering causes the parts to shrink. They are then sized, coldworked, and annealed. ***W. E. Whittington.*** *Metal Powder Association, Proceedings,* v. 14, 1958, p. 9-18. (TN695 M56p Vis.)

6914 The Effect of Sintering Atmospheres on the Properties of Sintered Iron Compacts. ***E. P. Kawasaki.*** *Metal Powder Association, Proceedings,* v. 14, 1958, p. 23-31. (TN695 M56p Vis.)

6915 Hydrogen and Dissociated Ammonia for Sintering. ***M. Robert Ogle.*** *Metal Powder Association, Proceedings,* v. 14, 1958, p. 32-36. (TN695 M56p Vis.)

6916 Exothermic and Purified Exothermic Atmospheres for Sintering. ***H. M. Webber.*** *Metal Powder Association, Proceedings,* v. 14, 1958, p. 37-41. (TN695 M56p Vis.)

6917 The Application of the Endothermic Atmosphere Generator to the Sintering of Powder Metallurgy Parts. ***Norbert K. Koebel.*** *Metal Powder Association, Proceedings,* v. 14, 1958, p. 42-46. (TN695 M56p Vis.)

6918 Frontiers of Powder Metallurgy in the U.S.S.R. Describes current research work in the fields of basic research; processing and testing techniques; powder metallurgy of Be, Ti, rare metals; and cermets, intermetallics, and dispersion alloys. ***Claus G. Goetzel.*** *Metal Powder Association, Proceedings,* v. 14, 1958, p. 47-54. (TN695 M56p Vis.)

6919 Present Status of the Powder Metallurgy Industry in Japan. ***J. Miyauchi.*** *Metal Powder Association, Proceedings,* v. 14, 1958, p. 55-64. (TN695 M56p Vis.)

6920 Slip Casting of Metal Powders. Fundamentals and advantages. Slip casting stainless steel and mixtures with UO_2. ***Henry H. Hausner.*** *Metal Powder Association, Proceedings,* v. 14, 1958, p. 79-90. (TN695 M56p Vis.)

6921 A New Viewpoint on Sintering. A description of some features of the geometry of sintering made by the use of the concepts of topology. ***Frederick N. Rhines.*** *Metal Powder Association, Proceedings,* v. 14, 1958, p. 91-101. (TN695 M56p Vis.)

6922 Hot Forming Techniques for Consolidating Metal Powders. Equipment, techniques, and applications for hot pressing, hot extrusion, hot rolling, and other methods. ***Harold H. Hirsch.*** *Metal Powder Association, Proceedings,* v. 14, 1958, p. 112-125. (TN695 M56p Vis.)

6923 Some Preliminary Experiments on the Continuous Compaction of Titanium, Molybdenum and Tungsten. Rolling of powders into sheet and strip followed by sintering. An Ar atmosphere was used for Ti and although strip of reasonable strength was produced, the ductility was low, due to contamination from the atmosphere. The Mo and W strip was sintered *in vacuo* but the green strength was low, probably as a result of the powder being too fine and having an unsatisfactory size distribution. The use of some form of binder and a H atmosphere is suggested. ***P. Evans and G. C. Smith.*** *Metallurgia,* v. 59, Mar. 1959, p. 117-120.

6924 Powder Metallurgy Continues Steady Gains. The metal powder industries have recovered from the recent recession rapidly and have scored gains, particularly in the auto industry. A 1959 survey has provided the first specific figures concerning powder metal usage. These show that about 15 lb. of powder metallurgy parts are going into the average passenger car this year. New uses include fabrication of valve rocker arm ball, and iron powder transmission oil pump rotor, and a timing chain sprocket and kick-down lever. *Metalworking,* v. 15, Mar. 1959, p. 16.

6925* Preparation and Hot Pressing of Uranium. Uranium powder is prepared by reduction of UO_2 by calcium. The CaO is eliminated by acetic acid at a low temperature. The uranium powder is pyrophoric; a special treatment allows it to be easily manipulated. The powder is sintered under load in a double-acting graphite assembly. This process also permits the preparation of alloys and cermets. (*In French.*) Préparation et frittage sous charge de l'uranium. ***J. Dubuisson, A. Houyvet, E. Le Boulbin, R. Lucas, and C. Moranville.*** *Revue de Metallurgie,* v. 56, Jan. 1959, p. 55-60.

6926* Sintering of Beryllia With 3 and 5 Per Cent Boron. The sintering of BeO containing 3 and 5% of B was investigated with the object of making protective shields against neutrons of various energies. The bricks forming these shields were obtained by sintering BeO and B_4C at 1,500 C under 150 kg. per sq. cm. pressure. Densities varied between 2.85 and 2.90 and dimensions of 100 x 100 x 50 mm. were attained to ± 0.1 mm. by machining after sintering. (*In French.*) Frittage de l'oxyde de béryllium à 3 et 5% de bore élément. ***R. Pointud, Ch. Rispal and M. Le Garec.*** *Revue de Métallurgie,* v. 56, Jan. 1959, p. 68-74.

6927 Breakthrough in Tungsten Fabrication Promises Wider Use of Pure Metal. Refractory properties make is desirable for many applications, but it's hard to work; with new techniques, it can be forged, extruded, deep drawn, or spun. *Steel,* v. 144, Mar. 23, 1959, p. 102-103.

6928 Delta-Phase Zirconium Hydride as a Solid Moderator. In a study of the preparation and properties of delta-phase zirconium hydride it was found that large, sound bodies of the hydride can be prepared by direct combination of the elements if the rate of the reaction is retarded by limiting the supply of available hydrogen. Specimens up to 1-in. diameter were prepared using this technique. Because delta-phase zirconium hydride does not readily form eutectics with iron- and nickel-base alloys below 1800 F these materials may be utilized for cladding the hydride. Delta-phase zirconium hydride is unaffected by exposure to liquid NaK or to nitrogen gas at temperatures below 1000 F. The hot hardness of delta-phase zirconium hydride is about 130 kg per mm^2 at room temperature and 40 kg. per mm^2 at 1500 F. The mean coefficient of thermal expansion (68 to 1337 F) is 6.5×10^{-6} per deg. F. The thermal conductivity varies from 5.7 Btu/(ft)(hr)(F) at 300 F to 5.1 Btu/(ft)(hr)(F) at 1300 F. ***James B. Vetrano.*** *U. S. Atomic Energy Commission, BMI-1243,* Dec. 18, 1957, 16 pp. (UF767 U3b Contin.)

6929 Further Studies of Sintered Refractory Uranium Compounds. The properties of a number of refractory binary compounds of U that may have potential application as nuclear fuels were investigated. The compounds UC and UC_2 were prepared by arc-melting methods, UN by gas-solid reactions, and UB_2 and UBe_{13} by solid-solid reactions. Techniques for sintering powder compacts of these compounds to densities 90% of theoretical or greater were developed. Mean linear thermal-expansion coefficients of 7.9×10^{-6} per F for UC and 9.3×10^{-6} per F for UBe_{13} were obtained in the range 68 to 1800 F. The thermal conductivity of sintered UBe_{13} increased from 0.050 cal/(sec)(cm)(C) at 100 C to 0.064 cal/(sec)(cm)(C) at 650 C. The electrical resistivity of sintered UBe_{13} was 113 michrohm-cm at 27.6 C. Knoop microhardness values varied from 500 for sintered UC_2 to 1155 for sintered UBe_{13}. ***Arch B. Tripler, Jr., M. Jack Snyder, and Winston H. Duckworth.*** *U. S. Atomic Energy Commission, BMI-1313,* Jan. 27, 1959, 54 pp. (UF767 U3b Contin.)

NONDESTRUCTIVE TESTING AND QUALITY CONTROL

6930 Using K-Capture X-Rays to Analyze Products in the Plant. Reviews the process, describes equipment design in detail, and discusses sampling considerations. Cites use in measuring ammonium chloride content in scrubbing tower wash water, and for determining calcium (sulfated ash) content in petrochemistry. ***Alan Beerbower.*** *Control Engineering,* v. 6, Mar. 1959, p. 128-131.

6931* Nondestructive Testing of Welded Fabrications. A board of 32 experts tell how to buy and where to use nondestructive testing equipment. Table sums up properties of X-ray, gamma, film, magnetic particle, ultrasonic, and penetrant

systems. *Industry & Welding*, v. 32, Mar. 1959, p. 41 + 11 pages.

6932* Use of the Beam Deflector to Ultrasonically Test Bronze Castings. Tests for gear porosity are made through the hub. Transducer heads are described. ***John C. Smack.*** *Nondestructive Testing*, v. 17, no. 2, Mar.-Apr., 1959, p. 85-88.

6933* The Rotary Radiographic Scanner, an Aid to the Inspection of Swaged Tubing. ***Alvin N. Hammer.*** *Nondestructive Testing*, v. 17, no. 2, Mar.-Apr. 1959, p. 89-91.

6934* New Industrial X-Ray System Halves Radiographic Inspection Costs. Cost and time are reduced by stronger X-ray source, more sensitive film, and better processing equipment. ***Benjamin F. Bower.*** *Nondestructive Testing*, v. 17, no. 2, Mar.-Apr. 1959, p. 93-95.

6935* What's Ahead for Nondestructive Electrical Testing. For reliability in today's electrical equipment in both central stations and industrial plants, maintenance men are taking a hard look at nondestructive testing. ***Norman Peach.*** *Power*, v. 103, Mar. 1959, p. 210-211.

6936 Quality Control and Industrial Statistics. A clear, understandable, and authoritative presentation of the why and how of current quality control procedures that describes these procedures and explains the theory underlying them. It covers those parts of statistical theory that are especially applicable to quality control procedures and industrial research. Includes a helpful review of the fundamentals of probability and statistical theory, followed by a thorough discussion of acceptance sampling by attributes and by variables. Control charts of all types are explained fully. ***Acheson J. Duncan.*** Rev. Ed. 946 pp. 1959. Richard D. Irwin, Inc., Homewood, Ill. (TS155 D91q2.)

NUCLEAR PHYSICS, NUCLEONICS, AND RADIATION

6937 Some Notes on the Strength of the Enrico Fermi Reactor Vessel Structure. Strain gaging during hydrostatic testing gave limited results. A successful high temperature strain-gaging technique for long-time static applications up to at least 900 F is developed and described. ***F. R. Beyer.*** *ASME, Transactions Series A, Journal of Engineering for Power*, v. 81, no. 1, Jan. 1959, p. 66-72.

6938* Determining the Parity of Hyperons and K-Mesons. A study of how the determination could be made without assuming spins of hypernuclei or the necessity of observing the reaction near the threshold, and starting by the investigation of the reaction with a polarized proton bunch. (*In Russian.*) Ob opredalenii chetnosti giperonov i k-mezonov. ***S. M. Bilen'kiĭ and R. M. Ryndin.*** *Akademiia Nauk SSSR, Doklady*, v. 124, no. 1, Jan.-Feb. 1959, p. 63-65.

6939* The Half-Lives of Some Electric Quadrupole Transitions in the Lead Region. Measurements of half-lives of isomeric nuclear states have been carried out on electromagnetically isotope separated samples with a 25-channel time analyzer. ***B. Johansson, T. Alväger, and W. Zuk.*** *Arkiv för Fysik*, v. 14, no. 5, 1959, p. 439-449.

6940* On Moments of Inertia of Strongly Deformed Odd-*A* Nuclei. Concludes that nuclei in the mass regions $A \sim 25$, $150 < A < 190$ and $A > 225$ possess rotational symmetry around the axis of deformation and furthermore also reflection symmetry with respect to a plane perpendicular to the axis of deformation. ***Owe Prior.*** *Arkiv för Fysik*, v. 14, no. 5, 1959, p. 451-471.

6941* Making the Best Use of Nuclear Fuels. Secondary fuels, produced in the reactor from non-fissile material, will be of great importance in a fully developed power program. ***M. D. Jepson.*** *Atomic World*, v. 10, Jan. 1959, p. 14-17.

6942* The Berlin Research Reactor (BER). A water boiler reactor of 50 kW nominal power. The fuel is uranyl sulphate with 20% U-235 in aqueous solution. The setting up of the primary system and the second shell, the concreting of the screen and the initiation of the reactor are described. (*In German.*) Der Berliner Forschungsreaktor (BER). ***E. W. Allen, et al.*** *Atomwirtschaft*, v. 4, no. 3, Mar. 1959, p. 94-96.

6943* The Photodisintegration of Nuclei with Z Between 9 and 30. Points out that the Danos-Okamoto effect (splitting of the giant resonance for non-spherical nuclei into two components) should be more readily observable in the region $9 \leq Z \leq 30$ than in the rare earth region where the initial search for the effect has been made. ***B. M. Spicer.*** *Australian Journal of Physics*, v. 2, no. 4, Dec. 1958, p. 490-501.

6944 Gamma-Ray Analysis of Atmospheric Dust Samples. Peaks from fission products Zr-95, Nb-95, Ru-103, Ce-141, Ce-144, and Cs-137, with half-lives of several days and longer, were identified. Products such as caesium-137 were not of sufficient activity to permit identification until the samples had decayed for several months. ***J. L. Horwood.*** *Canada, Mines Branch, Research Report, R-24*, Sept. 23, 1958, 20 pp. (TN26 C16.5r Contin.)

6945* Formation of Astatine 210 and 211 by Spallation of Thorium 232 by Means of 160 MeV Protons. The radiochemical separation of the different elements produced and the study of their decrease by α,β-emission or electron emission made it possible to measure the effective sections of different reactions (p, xp, yn) induced on thorium 232 by means of accelerated 160 MeV protons. Two isotopes of astatine of masses 210 and 211 were identified. (*In French.*) Sur la formation d'astate 210 et 211 par spallation du thorium 232 par des protons de 160 MeV. ***Marc Lefort, Gabriel Simonoff, and Xavier Tarrago.*** *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*, v. 248, no. 2, Jan. 12, 1959, p. 216-218.

6946* High Resolution and Measurement of Low Magnetic Fields by Means of Nuclear Magnetic Resonance. A sample of water containing many protons, placed in a constant alternating field and subjected to an alternating magnetic field H_1 perpendicular on the former, was the seat of a dipolar magnetic resonance for a frequency of the field H_1 defined by $\omega = \gamma H_0$ where for the proton $\gamma = 2.6753.10^4$ gauss^{-1}.s^{-1}. The acuteness of the resonance can be explained by the width of the line, in other words by the half height of the absorption curve. A spectrometer was described and used in measuring very low line widths. (*In French.*) Haute résolution et mesure des champs faibles par la résonance magnétique nucléaire. ***Gilbert Hochstrasser, Georges Béné, and Richard Extermann.*** *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*, v. 248, no. 2, Jan. 12, 1959, p. 218-220.

6947* Behavior of Semiconductor and Magnetic Materials in Radiation Environment. Charts and graphs are presented to illustrate results obtained and techniques for minimizing radiation effects are included. ***Alvin Boltax.*** *Electrical Manufacturing*, v. 63, Mar. 1959, p. 90-95.

6948* High-Temperature Gas-Cooled Reactor Project. Twelve European countries propose to combine in a five-year program for joint investigation of the use of high-temperature gas-cooled reactors for nuclear power stations and other applications. The new project is known as "Dragon." *Engineer*, v. 207, Mar. 13, 1959, p. 415-417.

6949 A Nuclear Reactor Control System. This paper describes the electronic control system for a large research reactor, emphasizing in particular the transistorized instrumentation and protection equipment. ***D. J. Niehaus, R. R. Hoge, and A. B. Van Rennes.*** *IRE Transactions on Industrial Electronics, PGIE-8*, Jan. 1959, p. 38-45. (TK1 In6.6ie Vis.)

6950 Introduction to Neutron Physics. Emphasis has been placed on experimentally demonstrated facts and methods by which the data were obtained. Where desirable to show the value of study of the neutron in the development of nuclear physics, abbreviated discussions of theory are included. References to original literature are made in all cases. ***L. F. Curtiss.*** 380 pp. 1959. D. Van Nostrand Co., Princeton, N. J. (QC721 C94i)

6951 Fusion of Heavy Hydrogen. A very brief review of the Geneva convention and of international efforts to accomplish fusion. ***T. E. Allibone.*** *Nature*, v. 183, Feb. 28, 1959, p. 569-573.

6952* The Bubble Chamber and Its Use in the Physics of Elementary Particles. A brief review of the principles of the bubble chamber physics. (*In German.*) Die Blasenkammer und ihre Anwendung in der Physik der Elementarteilchen. ***Von K. Gottstein.*** *Naturwissenschaften*, v. 46, no. 3, Feb. 1959, p. 97-102.

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6967* Steps in Designing a Gas-Cooled Reactor. Presents one of the many answers. ***K. J. Wootton.*** *Nuclear Power*, v. 4, Feb. 1959, p. 64-69.

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6983 Classification of the Energy Levels of Odd-Mass Nuclei in the Heavy-Element Region. The observed levels have been classified according to the level diagrams calculated by Nilsson for nuclei with prolate spheroidal deformations. ***F. S. Stephens, Frank Asaro, and I. Perlman.*** *Physical Review*, v. 113, ser. 2, no. 1, Jan. 1, 1959, p. 212-224.

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6985 "Anomalous" Scattering of μMesons. A μ-meson scattering experiment in which the mesons are required to traverse a thick block of iron and stop and decay in a thin layer of carbon, is reported. ***Shuji Fukui, Takashi Kitamura, and Yuzuru Watase.*** *Physical Review*, v. 113, ser. 2, no. 1, Jan. 1, 1959, p. 315-324.

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6988 The Physics of Elementary Particles. The goal is to present an introductory account of elementary particles physics with a minimum of formal apparatus and to provide an introduction to the subject from which the reader can go to the literature for a deeper probing. Only the simplest fundamental processes have been treated. ***J. D. Jackson.*** 135 pp. 1958. Princeton University Press, Princeton, N. J. (QC721 J13p)

6989* Interpretation of the Optical Model in Nuclear Reactions. Argues in connection with statistical mechanics of irreversible processes that the characteristic feature of the optical model can be revealed by means of wave packets whose energy spread is wide enough to cover many compound levels. ***Satio Hayakawa, et al.*** *Progress of Theoretical Physics*, v. 21, no. 1, Jan. 1959, p. 85-97.

6990* Radiative K-μ Decay and Quantum Electrodynamics at Small Distances. Above is analyzed as a means of obtaining information on the properties of the muon and Q.E.D. at small distances and (or) on the type of the weak Fermi interaction. To express modifications of the properties of the muon and of Q.E.D. at small distances, cut-off factors are used. ***Kichiro Hiida.*** *Progress of Theoretical Physics*, v. 21, no. 1, Jan. 1959, p. 98-112.

6991* On the Validity of Dispersion Relations in Perturbation Theory. Relations with the ordinary threshold energies are proved in every order of perturbation expansion for eleven forward scatterings. ***Noboru Nakanishi.*** *Progress of Theoretical Physics*, v. 21, no. 1, Jan. 1959, p. 135-150.

6992* Low Energy Kaon-Nucleon Reactions. Reactions are investigated in the case in which the kaon-nucleon-hyperon interaction is of the scaler type, with the nonrelativistic approximation. Direct interactions between kaons and pions are not considered. ***Akira Komatsuzawa, Reiji Sugano, and Yukihisa Nogami.*** *Progress of Theoretical Physics*, v. 21, no. 1, Jan. 1959, p. 151-173.

6993* Properties of Nuclear Forces Indicated by $d(\gamma, p)n$. A rather repulsive property of ^1E, the strong tensor forces of ^3O and ^3E are pointed out, and the detailed forms of the potentials are discussed. Comparison with nucleon-nucleon scattering is made. ***Shih-Hui Hsieh.*** *Progress of Theoretical Physics*, v. 21, no. 1, Jan. 1959, p. 185-206.

6994* Longitudinal Motion of Electrons and Allowances in a Linear Accelerator. Some problems of the dynamics of particles in high-energy linear accelerators are considered. Injection conditions are determined which provide effective acceleration and compactness of the energy spectrum of accelerated particles. The formulas derived made it possible to establish allowances for frequency, temperature, and dimensions of the accelerator waveguide. (*In Russian.*) Prodol'noe dvizhenie elektronov i dopuski v lineĭnom uskoritele. ***A. D. Vlasov.*** *Radiotekhnika i Élektronika*, v. 4, no. 2, Feb. 1959, p. 295-302.

6995* Reactor Core Materials. A review of recent developments in solid materials for reactor cores including U, Pu, Th, and their alloys; moderator and control materials; cladding and structural materials; and special fabrication techniques. ***R. W. Dayton and E. M. Simons, editors.*** *Reactor Core Materials*, v. 2, no. 1, Feb. 1959, 53 pp.

6996 The Weak Interactions. These reactions are now recognized as reflecting a fourth force of nature. The other three are gravity, electromagnetism, and the "strong" force which holds together the particles of the atomic nucleus. ***S. B. Treiman.*** *Scientific American*, v. 200, no. 3, Mar. 1959, p. 72 + 10 pages.

6997 Dispersion Relation for Process $\pi + N \rightarrow \pi' + \pi'' + N'$ in Approximation of a Quiescent Nucleon. A considerable part of the unobservable region is covered by a continuous spectrum, whose approx. calculation leads to an integral equation between Hermitian and non-Hermitian parts of amplitude of process. ***V. Tsellner, O. Khrustalev, V. Serebriakov, and A. Leznov.*** *U. S. Atomic Energy Commission, AEC-tr-3540*, Nov. 1958, 14 pp. (Translated from Russian.) (UF767 Un3.1ae Contin.)

6998 The Argonne 60-Inch Cyclotron. This constant-frequency machine has been in productive operation since July 10, 1952. Deflected beams of deuterons, helium ions, singly-charged hydrogen molecules and neutrons of a broad energy spectrum are constantly in demand. ***W. J. Ramler and G. W. Parker.*** *U. S. Atomic Energy Commission, ANL-5907*, Feb. 1959, 38 pp. (UF767 Un3.1an Contin.)

6999 The Activity of the Fission Products of U^{235}. Provides data for short time activities up to a few hours after shutdown which must be known in order to allow estimation of such effects as the heat generation in the fuel, moderator, structural material and the like of a reactor during reactor operation and immediately following the start of a reactor shutdown or scram. ***W. E. Knabe and G. E. Putnam.*** *U. S. Atomic Energy Commission, APEX-448*, Oct. 31, 1958, 89 pp. (UF767 Un3.1ap Contin.)

7000 Hazards Summary Report for the Reflector-Control Critical-Assembly Experiments. Hazards calculations are made to determine the dosage from direct irradiation, fall-out, and inhalation from a radioactive cloud resulting from an accident. The exclusion area is shown to be adequate for even the maximum hypothetical accident. ***Francis J. Jankowski, et al.*** *U. S. Atomic Energy Commission, BMI-1166*, Feb. 12, 1957, 80 pp. (UF767 U3b Contin.)

7001 Critical-Assembly Experiments on a Reflector Control System for a Boiling Reactor. Results indicate that sufficient reactivity is available in the reflector to compensate for large power variations and equilibrium poisons. However, the reactivity worth is not great enough in the system considered to include startup from the cold condition or long-time fuel burnup. ***David A. Dingee, et al.*** *U. S. Atomic Energy Commission, BMI-1245*, Dec. 20, 1957, 45 pp. (UF767 U3b Contin.)

7002 Thorium-U^{233} Symposium. An exchange of ideas and a discussion of the problems of the entire Th U^{233} cycle. *U. S. Atomic Energy Commission, BNL-483* (C-26), Jan. 9-10, 1958, 200 pp. (UF767 Un3.1bn Contin.)

7003 Liquid Metal Fuel Reactor. The U-Bi Liquid Metal Fuel Reactor systems were originally conceived as a Th-U^{233} breeder power reactor system. While various kinds of LMFR's have been studied, such as U^{235} or Pu burners, it is believed that in the long run LMFR's will be economically successful only if they convert Th to U^{233} at about a one to one ratio. This system will be pushed to the utmost, with a greater increased emphasis on the blanket than in the past. It is felt that in the long run the many advantages of the Liquid Metal Fuel Reactor system with built-in processing will prove to be the most economical way of burning thorium. ***Clarke Williams.*** *U. S. Atomic Energy Commission, BNL-483* (C26), Jan. 9-10, 1958, p. 20-22. (UF767 Un3.1bn Contin.)

7004 The Decontamination of Reactors and Reactor Loops. A Literature Review. Objective is to assemble and organize the data on reactor decontamination in order to help in the development and selection of compatible materials and decontaminants. Lists 71 references. ***B. Griggs.*** *U. S. Atomic Energy Commission, HW-57642*, Nov. 11, 1958, 23 pp. (UF767 Un3.1hw Contin.)

7005 High Energy Neutrons in a Collimated Beam From the Los Alamos Fast Plutonium Reactor. Neutrons were observed in the energy range of 24 to 25 Mev, implying fragment excitation energies greater than 30 Mev. In the spectrum no change of slope is evident, suggesting that fragments of still higher excitation are reasonably abundant. ***Bob E. Watt.*** *U. S. Atomic Energy Commission, LA-2185*, Feb. 1951, (issued Feb. 16, 1959) 30 pp. (UF767 U3La Contin.)

7006 Development and Production of SRE Fuel Elements. Describes development of a seven-rod fuel element, each rod containing slugs of slightly enriched metallic uranium bonded to a thin-wall stainless-steel tube with liquid sodium-potassium eutectic alloy. ***J. J. Droher, W. J. Hallett, and H. Strahl.*** *U. S. Atomic Energy Commission, NAA-SR-2007*, May 15, 1958, 53 pp. (UF767 Un3.1na Contin.)

7007 Neutron Moderation by Chemically Bound Hydrogen. The fact that typical level spacings of chemically bound protons are considerably larger than thermal energies kT at typical reactor temperatures, necessitates including the effects of binding in treating neutron thermalization by hydrogenous moderators. ***E. U. Vaughan and E. R. Cohen.*** *U. S. Atomic Energy Commission, NAA-SR-3376*, Jan. 15, 1959, 17 pp. (UF767 Un3.1na Contin.)

7008 Design and Feasibility Study of a Pebble Bed Reactor-Steam Power Plant. Plant design and system analysis. *U. S. Atomic Energy Commission, NYOO 8753*, May 1, 1958, Sections individually paged. (UF767 Un3.nyo Contin.)

7009 Determination of the Neutron Diffusion Parameters in Room-Temperature Beryllium. The pulsed neutron method was used. Data are reported and compared. ***G. deSaussure and E. G. Silver.*** *U. S. Atomic Energy Commission, ORNL-2641*, Feb. 27, 1959, 36 pp. (UF767 U3o Contin.)

7010 Papers Presented at the Reactor Fuel Measurement Techniques Symposium Held at Kellogg Center, Michigan State University, East Lansing, Michigan, June 18-20, 1958. Consists of 23 papers. Goal is that the techniques for analyzing nuclear fuels keep pace with the advancing fabrication technology. *U. S. Atomic Energy Commission, TID-7560*, Jan. 1958, 208 pp. (UF767 Un3ti Contin.)

7011 Proceedings of the 1958 Nuclear Merchant Ship Symposium, Washington, D. C. August 21, 1958. *U. S. Atomic Energy Commission, TID-7563*, Jan. 14, 1959, 200 pp. (UF767 Un3ti Contin.)

7012 Information Meeting on Gas-Cooled Power Reactors. Contains the 22 papers presented. *U. S. Atomic Energy Commission, TID-7564*, Dec. 1958, 372 pp. (UF767 Un3ti Contin.)

7013 Semi-Empirical Neutron Cross Sections. 0.5-15 Mev. pt. II, v. I. Presents "best values" from a myriad of sources. ***Robert J. Howerton.*** *U. S. Atomic Energy Commission, UCRL-5351*, Nov. 1958, 274 pp. (UF767 U3u Vis.)

7014 Gas Cherenkov Counters. Counter is suitable for charged-particle detection in the Bev region (β from 0.980 to 0.999). Calibrations of the counting efficiency are included along with a table of indices of refraction of suitable gases. ***Victor Perez-Mendez and John H. Atkinson.*** *U. S. Atomic Energy Commission, UCRL-8570*, Dec. 23, 1958, 19 pp. (UF767 U3u Contin.)

7015 Reactor Chemistry and Plant Materials. Consists of ten papers on contamination and removal, corrosion under irradiation, analysis of Zr and Zircaloy, and torsion in spring alloys. *U. S. Atomic Energy Commission, WAPD-BT-11*, Dec. 1958, 145 pp. (UF767 Un3.1wb Contin.)

7016 NASA Reactor Facility Hazards Summary. II. Supplements to volume I are presented with information unavailable when volume I was written, an evaluation of the proposed nuclear facility, and answers to questions. *U. S. National Aeronautics and Space Administration, NASA Memorandum 12-10-58E*, Feb. 1959, 194 pp. (TL782 Un3rm Vis.)

7017 A Guide to Nuclear Power. IV. Thermonuclear Fusion. A simplified explanation of the process and the problems presented. How and when the solutions will be found is still unknown. ***W. D. Biggs.*** *Welding Engineer*, v. 44, Mar. 1959, p. 40-43.

7018* Determining the Trajectories of Relativistic Charged Particles in Electric and Magnetic Fields by the Adams Method of Finite Differences. The following cases were considered: constant and variable electrical and constant magnetic fields of an arbitrary form, the same fields but in the presence of a variable magnetic field symmetrical around its axis. Meth-

ods for evaluating the accuracy, and examples were given. (*In Russian.*) Nakhozhdenie traektoriĭ reliativistskikh zariazhennykh chastits v elektricheskikh i magnitnykh poliakh metodom konechnykh raznosteĭ adamsa. ***N. I. Shtepa.*** *Zhurnal Tekhnicheskoĭ Fiziki*, v. 29, no. 1, Jan. 1959, p. 120-127.

See also: **6134** (cooling of atomic rockets); **6135** (Russian atomic airplane); **6218** (properties of graphite); **6256** (nuclear fuel processing); **6640** (H-bomb and Athabaska oil sands); **6641** (cosmic electrodynamics); **6665** (photography of nuclear explosion); **6666** (hybrid nuclear-chemical rocket propulsion); **6852** (ductility of reactor Be); **6893** (phase changes in irradiated U-Mo alloy); **6929** (sintered uranium fuels); **7077** (isotope separation).

OPERATIONS RESEARCH AND MANAGEMENT ENGINEERING

7019* Changing Patterns of Organizational Authority: The Military Establishment. The movement from domination to manipulation seems to be a general pattern of social change. The fact that is it present even in the military is of particular theoretical importance. ***Morris Janowitz.*** *Administrative Science Quarterly*, v. 3, no. 4, Mar. 1959, p. 473-493.

7020* Bureaucratic Theory and Comparative Administration. Bureaucratic theory should stress essential structural features, thus permitting research into various patterns of bureaucratic behavior in both western and nonwestern societies. ***Ferrel Heady.*** *Administrative Science Quarterly*, v. 3, no. 4, Mar. 1959, p. 509-525.

7021 Employee Relations Facts: Sources and Control. The first of two articles listing the sources of information about personnel and industrial relations, with commentary. ***Bernard G. Naas.*** *American Business*, v. 29, Mar. 1959, p. 32-35.

7022 Analyses of Industrial Operations. The articles are arranged according to method of analysis: Section I, Applications of Linear Programming; Section II, Other Programming Applications; Section III, Waiting Line Applications; Section IV, Applications of Incremental Analysis; Section V, Total Cost and Value Models. ***Edward H. Bowman and Robert B. Fetter, editors.*** 485 pp. 1959. Richard D. Irwin, Inc. Homewood, Illinois. (TS155 B68ai)

7023 Selecting Control Devices for Human Operators. While only the more common control devices are listed, others may be more appropriate for certain applications due to design peculiarities. ***George A. Peters and Stan Michelson.*** *Control Engineering*, v. 6, Mar. 1959, p. 127.

7024 Creative Leadership. Describes the creative leader as the man or woman who can evaluate a situation, balance the conflicts and tensions within the group involved, and channel individual energies and needs toward constructive action. Tells how the individual goal-seeking pattern combines and directs the goal-seeking pattern of the group. ***Roger Bellows.*** 338 pp. 1959. Prentice-Hall, Englewood Cliffs, N. J. (HD6961 B41c)

7025 Does Big Business Breed Conformity? Is the "organization man" guilty as charged? Here's the considered verdict of a panel of top company presidents who set the organizational climate for a sizable segment of U. S. industry. *Dun's Review and Modern Industry*, v. 73, no. 3, Mar. 1959, p. 41 + 6 pages.

7026 Building a Profit-Minded Middle Management. Sun Chemical's plan for achieving flexible, highly autonomous operation of its diversified divisions offers some helpful clues for any management seeking to tie executive progress to company profits. ***Norman E. Alexander.*** *Dun's Review and Modern Industry*, v. 73, no. 3, Mar. 1959, p. 46 + 4 pages.

7027 Planning Tomorrow's Plants; Industry Gears up for a Decade of Expansion. A 5-part special report to management. Across the nation companies are readying plans to meet the floodtide of demand expected in the Soaring "60"s. This major feature highlights fresh trends and practical techniques in planning, designing, and locating new plants. *Dun's Review and Modern Industry*, v. 73, no. 3, Mar. 1959, p. 59 + 49 pages.

7028* The Role of the Technical Assistant in Industry. There is a growing need in industry for well-trained technical assistants, and a system should be developed to give these people recognized status. ***J. R. Houghton.*** *Engineering Journal*, v. 42, Feb. 1959, p. 70-73.

7029 Queuing Theory—Its Application in Operations Research. ***T. S. George.*** *Florida. University. Engineering and Industrial Experiment Station. Leaflet Series No.* 101, (Supplement), Nov. 1958, 9 pp. (TA1 F66L Contin.)

7030 Systems Engineering and Weapon System Management. The design problems caused by introduction of jet engines, missiles, and complex electronic systems, in the post-World War II period engendered a developmental pattern which emphasized the need for integration of all components. Thus, systems engineering and operations analyses are necessary parts of modern weapons management. ***L. I. Davis.*** *IRE Transactions on Military Electronics*, v. MIL-3, no. 1, Jan. 1959, p. 4-7. (TK1 In6.6mi Vis.)

7031 Systems Engineering. A description is given of practical systems engineering methods as applied to large military systems in an industrial environment. Particular emphasis is placed on a design approach which stresses minimum interconnections between subsystems and on system testing methods. ***R. H. Jewett and R. A. Montgomery.*** *IRE Transactions on Military Electronics*, v. MIL-3, no. 1, Jan. 1959, p. 12-18. (TK1 In6.6mi Vis.)

7032 How to Get More From Your Data Processing System. ***E. W. Mitchell.*** *Iron Age*, v. 183, no. 11, Mar. 12, 1959, p. 121-123.

7033 Here's How a Psychologist Looks at the Future of an Engineer. What does "getting ahead" mean for engineers? What are the opportunities? What does it take? What does it "cost"? This article is based on a talk presented at the Fifth Conference on Mechanisms. ***Richard W. Wallen.*** *Machine Design*, v. 31, Mar. 5, 1959, p. 96-100.

7034 Computers Now Police Job-Shop Production. Faster machines and higher production rates have revealed weaknesses in scheduling and work loading in many shops. Alco Products Inc. set up a system that turns the burden of production control over to a computer. Guesswork on completion dates has been eliminated and computer points out bottlenecks. ***R. W. Curtis and Robert A. Hale.*** *Metalworking*, v. 15, Mar. 1959, p. 3-5.

7035 Do You Want To Be a Manager? ***Ernestine Adams.*** *Petroleum Engineer*, v. 31, Mar. 1959, p. A22-A24.

7036 Do You Know the Functions of Management? If you want to be a manger, you must know the functions of organization and the factors that go to make up the activity of managing. You must know the elements in the system that cause success or failure of an organization. ***Wilson J. Bentley.*** *Petroleum Engineer*, v. 31, Mar. 1959, p. A25-A27.

7037* What Is Linear Programming? The first of a series of articles on linear programming and its applications. Ten exemplary problems are given. ***S. Vajda.*** *Process Control and Automation*, v. 6, Jan. 1959, p. 15 + 5 pages.

See also: **6133** (operational analysis in guided missile research); **6575** (economic planning by computers).

ORE AND MATERIALS BENEFICIATION

7038 Electrolysis as a Method for Interconnecting Certain Metallurgical and Chemical Industries. Industrial electrolysis suffers from the low intensity of the processes, insufficiently stable anodes and high anodic potentials, low utilization of the "second" electrode products. An improvement of

many processes is possible if instead of the independent improvement of separate production steps, an attempt is made to connect electrolysis in metallurgy with the chemical industry, the vice versa. The basis for such an interconnection is a new system for anode operation. The utilization, in the metallurgy of the rare metals, of the amalgams forming the cathodic products of the electrolytic manufacture of chlorine using a mercury cathode is a further example of the interconnection of chemistry and metallurgy via the electrode processes. ***V. V. Stender.*** Paper from "The Academy of Sciences of the USSR, Division of Chemical Science, Reports of the Fourth Soviet Conference on Electrochemistry, Oct. 1-6, 1956", Consultants Bureau, Inc., New York, 1958, p. 77. (QD552 So89ttr)

7039 Some Problems in the Metallurgy of Amalgams—The Cementation of Metals by Amalgams. Amalgam metallurgy is based on the selective transfer of metals into Hg with the formation of amalgams and the subsequent selective extraction of the metals from the amalgams obtained. Two methods may be used for the transfer of metals into the Hg from their aqueous solution: electrolysis with a Hg cathode and cementation by amalgams. The selective extraction of the metals from the amalgams obtained may also be achieved by methods involving electrolysis using amalgams as anodes or by a cementation method. Possible formation of intermetallic compounds in the amalgams must be considered. ***M. T. Kozlovskii.*** Paper from "The Academy of Sciences of the USSR, Division of Chemical Science, Reports of the Fourth Soviet Conference on Electrochemistry. Oct. 1-6, 1956". Consultants Bureau, Inc., New York. 1958, p. 78. (QD552 So89ttr)

7040 Properties of Fluxed Sinter. Determination of quantity of combined iron oxides in various sinters by reduction at intermediate temperatures; and elucidation of kinetic aspects of process of reduction, based on study of about one hundred production samples. ***N. L. Gol'dshtein and N. S. Khromenko.*** *Henry Brutcher Translation No.* 4386, 18 pp. (From *Stal'*, v. 18, no. 7, 1958, p. 586-593.) Henry Brutcher, Altadena, Calif.

7041 Application of Continuous Filters in the Metallurgical Flow-Sheet. Based on cake formation, cake de-watering, cake washing, and cake thermal drying rates. ***D. A. Dahlstrom.*** *Canadian Mining and Metallurgical Bulletin*, v. 52, no. 562, Feb. 1959, p. 94-111; *Canadian Institute of Mining and Metallurgy, Transactions*, v. 62, 1959, p. 26-43.

7042 Dry Cleaning and Washing Fines at Crichton No. 4 Mine. New fine-coal dry cleaning and auxiliary wet washing facilities at Johnstown Coal & Coke Co. permit shipping an accurately screened 3/8x0 product averaging three percentage points lower in ash. *Coal Age*, v. 64, Mar. 1959, p. 88-91.

7043 Desliming and Heat Drying. Analysis of desliming and heat drying, and report on operating results with a new-type heat drier handling 5/8x0 coal. ***R. M. Grimm.*** *Coal Age*, v. 64, Mar. 1959, p. 104-107.

7044 Recent Developments in Coal Flotation. Describes the froth flotation method of coal washing and discusses in detail the main factors which influence the process. ***N. Pilpel.*** *Industrial Chemist*, v. 35, Feb. 1959, p. 82-86.

7045* Iron by Direct Reduction. A description of the American Strategic-Udy process. ***J. Grindrod.*** *Mining Magazine*, v. 100, no. 2, Feb. 1959, p. 73-78.

7046* At Trout Lake: HMS Addition Rejects More Silica. The Oliver Mining Division of U. S. Steel Corporation now has two HMS units handling 814 dry tons per hour. Magnetite media from HMS cyclone circuit is recovered by screening. *Mining World*, v. 21, no. 3, Mar. 1959, p. 34-38.

7047 Separation of Cerium From Other Rare Earths by Ignition of the Nitrates. The cerous nitrate was decomposed to ceric oxide. Small scale investigations were made using sodium nitrate and magnesium nitrate hexahydrate as fluxes. Sodium nitrate ignition proved to be more economical. The ceric oxide obtained was quite pure. ***Russell W. Johnson and Edwin H. Olson.*** *U. S. Atomic Energy Commission, ISC-1069*, Sept. 1958, 31 pp. (UF767 Un3.lis Contin.)

7048 Experiments in Concentrating Lead Sulfide Slime. Mineral-dressing research on flotation tailing from the St. Joseph Lead Co., Bonne Terre, Mo. ***D. W. Frommer and M. M. Fine.*** *U. S. Bureau of Mines Report of Investigations* 5444, 1959, 13 pp. (Tn21 Un3r Vis.)

See also: **6576** (mineral dressing economics); **6639** (flash roasting of Zn concentrate).

PHYSICS

7049 On Propagation of Waves in Slightly Rough Ducts. Both acoustic and electromagnetic waves are treated. ***J. Clifton Samuels.*** *Acoustical Society of America, Journal*, v. 31, Mar. 1959, p. 319-325.

7050 Sound Absorption in Nitrogen and Oxygen. Values up to 44 Mc/s atm are reported. The simple hypothesis of a single time constant rotational relaxation in no way correlates the absorption and velocity measurements. ***H. D. Parbrook and W. Tempest.*** *Acustica*, v. 8, no. 6, 1958, p. 345-350.

7051 The Theory of Superconductivity. No attempt is made to describe the phenomenological developments, nor the extent to which the phenomenological theories account for the experimental results. ***C. G. Kuper.*** *Advances in Physics*, v. 8, no. 29, Jan. 1959, p. 1-44.

7052 The Modern Theory of Superconductivity. Concludes that superconductivity has at last been explained by agreement of the theory of Bardeen, Cooper, and Schrieffer with experiment which is based on the model of a Hamiltonian with a four-fermion interaction. ***I. M. Khalatnikov and A. A. Abrikosov.*** *Advances in Physics*, v. 8, no. 29, Jan. 1959, p. 45-86.

7053* Propagation of a Heat Wave of Nearly Spherical Shape. Based on the fact established in a previous study, that the spectrum of the eigenvalues and the corresponding eigenfunctions can be clearly defined, an equation of the heat supply in the case of a nonlinear thermal conductivity was developed, leading to the construction of an integral system of eigenfunctions. (*In Rusisan.*) O rasprostranenii teplovoĭ volny, blizkoĭ k sfericheskoĭ. ***R. M. Zaidel', O. S. Ryzhov, and E. I. Andriankin.*** *Akademiia Nauk SSSR, Doklady*, v. 124, no. 1, Jan. 1, 1959, p. 57-59.

7054* On Experimental Procedure in Studying Secondary Processes Induced by Ions When the Temperature of the Target Is High and Thermionic Emission Is Present. Determining the coeffiicent of the secondary ion emission as the ratio between the sum of the components of the secondary ion currents and the primary ion current, the value of this coefficient depending in a complex way upon the energy, ionization potential, ion mass, temperature, work function and masses of the target atoms. (*In Russian.*) O metodike issledovaniia vtorichnykh protssessov, vyzyvaemykh ionami pri vysokikh temperaturakh misheneĭ v prisutstvii termoelektronnoĭ emissii. ***U. A. Arifov, A. Kh. Aiukhanov, S. V. Starodubstev, and Kh. Kh. Khadzhimukhamedov.*** *Akademiia Nauk SSSR, Doklady*, v. 124, no. 1, Jan. 1, 1959, p. 60-62.

7055* Diffraction of Surface Sound Waves on Semi-Infinite Impedance Pipe and Rod. In order to solve the problem with the diffraction described, an infinite system of algebraic equations was obtained; this system can be solved by a successive approximation method and can also be applied to the electromagnetic case. (*In Russian.*) Difraktsiia poverkhnostnykh zvukovykh voln na polubeskonechnykh impedansnykh trube i sterzhne. ***Guan' Din-Khua.*** *Akademiia Nauk SSSR, Doklady*, v. 124, no. 3, Jan. 21, 1959, p. 559-562.

7056* Enhanced Stability of the Electric Arc in a Magnetic Field and the Principle of Field Maximum. The variations of the stability of the arc as function of the internal conditions of the discharge were investigated in order to understand the nature and role of the internal instability of the cathode spot on cold cathodes in the case of an arc with a mercury cathode. (*In Russian.*) Uvelichenie ustoĭchivosti dugi v magnitnom pole i printsip maksimuma polia. ***I. G. Kesaev.*** *Akademiia Nauk SSSR, Doklady*, v. 124, no. 3, Jan. 21, 1959, p. 563-566.

7057 Twin Paradox in Special Relativity. The familiar "traveling twin paradox" is discussed in a particularly simple manner, using special relativity only. ***Robert H. Romer.*** *American Journal of Physics*, v. 27, no. 3, Mar. 1959, p. 131-135.

7058 Structure of Uniform Liquids. Explains why calculations of the properties of classical liquids are, at the present time, based upon a detailed and accurate knowledge of the distribution of pairs of molecules within the liquid. ***G. H. A. Cole.*** *American Journal of Physics*, v. 27, no. 3, Mar. 1959, p. 136-146.

7059 Molecular Models: Expressions of the Transport and Virial Coefficients. Review transport and the virial coefficients from the point of view of their expressions as derived from rigid sphere, Sutherland, inverse power, and Lennard-Jones models. ***Juan A. McMillian.*** *American Journal of Physics*, v. 27, no. 3, Mar. 1959, p. 151-160.

7060* Gravitation—An Enigma. Concludes that it is a serious lack of observational data that fogs a clear portrait of gravitation. The most fundamental of the physical concepts are based on numbers which may be off by a factor of 100. ***R. H. Dicke.*** *American Scientist*, v. 47, no. 1, Mar. 1959, p. 25-40.

7061* The World of Fine Particles. Unique qualities of the direct information that is given by the electron microscope. ***John Turkevich.*** *American Scientist*, v. 47, no. 1, Mar. 1959, p. 97-119.

7062* Einstein's Equations and Classical Hydrodynamics. Aims to put the approximation procedure on a sound basis by the introduction of dimensionless variables in the general relativity equations. ***Judith Blankfield and G. C. McVittie.*** *Archive for Rational Mechanics and Analysis*, v. 2, no. 4, Jan. 19, 1959, p. 337-354.

7063* A Method of Solution of the Equations of Magnetohydrodynamics. The motion of the gas is regarded as controlled by its pressure-gradient and the magnetic field. The physical situation is that of a slab of gas, of infinite lateral extent, with parallel plane boundaries. It is shown that in adiabatic motion the slab can expand until it obtains a finite width and an equilibrium configuration. ***Judith Blankfield and G. C. McVittie.*** *Archive for Rational Mechanics and Analysis*, v. 2, no. 5, Feb. 4, 1959, p. 411-422.

7064* Rotational Analysis of the Ultraviolet Band System of CS. An analysis of 24 bands. ***A. Lagerqvist, H. Westerlund, C. V. Wright, and R. F. Barrow.*** *Arkiv för Fysik*, v. 14, no. 5, 1959, p. 387-408.

7065* The Constancy of the Velocity of Light. The principle is discussed from a historical point of view, is carefully analyzed, and is stated in a form which seems free from ambiguity. In the context of the restricted theory the "velocity of light" must always be interpreted as "the velocity of light measured in an inertial reference system" and it must be understood that this measured value is the average speed measured over a go-and-return path. ***G. Builder.*** *Australian Journal of Physics*, v. 2, no. 4, Dec. 1958, p. 457-480.

7066* Spectrographic Results Showing Evidence of a Condition Necessary for the Formation of an Intermolecular Hydrogen Bond. Complemental spectrographic results confirmed the already admitted hypothesis of the formation of an intermolecular hydrogen bond being directly connected with the vibration frequency of the dipoles securing the bond. (*In French.*) Résultats spectrographiques mettant en évidence une condition nécessaire à etablissement d'une liaison hydrogenène intermoléculaire. ***Marie-Madeleine Gerbier and Jean Gerbier.*** *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*, v. 248, no. 5, Feb. 2, 1959, p. 669-671.

7067* Fundamentals of Ferromagnetism. A completely new approach to the study of magnetism that not only summarizes the properties of presently known (and yet to come) permanent magnet materials, soft magnetic alloys and ferrites, but also looks 'inside' at the underlying electron interactions that do the actual work. ***Anthony Arrott and J. E. Goldman.*** *Electrical Manufacturing*, v. 63, Mar. 1959, p. 109-140.

7068 Transactions of the Florida Seminars on Spectroscopy, 1955-1957. A compilation of papers presented at the Third, Fourth, and Fifth Florida Seminars on Spectroscopy. Covers high resolution spectroscopy, special spectrochemical techniques, and applications. *Florida. University. Engineering and Industrial Experiment Station Bulletin No.* 100, Nov. 1958, 92 pp. (TA1 F66b Contin.)

7069* Atomic Energy Levels Shifts in Hydrogen-Like Atoms. Poses the problem of the so-called "½ megacycle discrepancy" existing between the experimental and the theoretical Lamb-shifts for hydrogen and deuterium. The high precision measurements of these level-shifts which confirmed the success of quantum electrodynamics has at the same time, raised doubts as to the validity of that theory. ***A. Petermann.*** *Fortschritte der Physik*, v. 6, no. 10, 1958, p. 505-523.

7070 Electron-Beam Flow in Superimposed Periodic and Uniform Magnetic Fields. Theoretical and experimental results are presented on the focusing of an electron beam by means of a magnet structure which produces, along the axis of the beam, a periodic magnetic field superimposed on a uniform field. ***J. R. Anderson.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 1, Jan. 1959, p. 101-105. (TK1 In6.6ed Vis.)

7071 Space-Charge Simulation in an Electrolytic Tank. The method of simulation is used as a means for introducing detailed space-charge effects into the determination of electron trajectories in axially symmetric, high-perveance electron guns. ***T. Van Duzer and G. R. Brewer.*** *Journal of Applied Physics*, v. 30, Mar. 1959, p. 291-301.

7072 Electrodynamic Containment of Charged Particles. Electrically charged iron and aluminum particles having diameters of a few microns have been contained in a confined region of space by means of alternating and static electric fields. ***R. F. Wuerker, H. Shelton, and R. V. Langmuir.*** *Journal of Applied Physics*, v. 30, Mar. 1959, p. 342-349.

7073 Impurity Compensation and Magnetoresistance in *p*-Type Silicon. A new method involves finding the total concentration of impurities in a sample from a measurement of the weak-field transverse magnetoresistance at 77 K and combining this result with the excess of acceptors over donors determined from a room-temperature resistivity or Hall effect measurement. ***Donald Long, C. D. Motchenbacher, and John Myers.*** *Journal of Applied Physics*, v. 30, Mar. 1959, p. 353-362.

7074 Theoretical Investigations on the Light Scattering of Colloidal Spheres. V. Forward Scattering. The above is calculated by means of the Mie theory as a function of a and m. In addition to the i values, the experimentally important quantity, I_{180}/I_{0C}, obtainable by Zimm plots, is evaluated. ***Wilfried Heller, Masayuki Nakagaki, and Morton L. Wallach.*** *Journal of Chemical Physics*, v. 30, Feb. 1959, p. 444-450.

7075* Scaling Problem, Virial Theorem, and Connected Relations in Quantum Mechanics. Shows that, for an equilibrium state as well as for fixed nuclei, one can by a proper choice of the scale factor always get the virial theorem satisfied for an arbitrary normalizable trial function. ***Per-Olov Löwdin.*** *Journal of Molecular Spectroscopy*, v. 3, no. 1, Feb. 1959, p. 46-66.

7076* Low-Frequency Vibrations and the Vibrational Spectra of Molecular Crystals. II. A relationship previously derived is obtained in a more rigorous manner. The procedure demonstrates the need for integrated band intensities in calculating dichroic ratios. ***R. M. Hexter.*** *Journal of Molecular Spectroscopy*, v. 3, no. 1, Feb. 1959, p. 67-72.

7077 Kinetic Theory of Gases. A short book emphasizing the essential and currently important parts of the subject, progressing from elementary to advanced levels. Covers recent advances, including an entire chapter on thermal diffusion and its application to isotope separation. ***R. D. Present.*** 280 pp. 1958. McGraw-Hill, New York. (QC175 P92k)

7078 X-Ray and Neutron Scattering From Electrons in a Crystalline Field and the Determination of Outer Electron Configurations in Fe and Ni. The effect of nonspherical charges distributions on X-ray and neutron scattering factors is calculated for d and f electrons in cubic, tetrahedral and

hexagonal fields. The measured X-ray and neutron scattering factors are then analyzed to determine the outer electron distribution in Fe and Ni and compare with the calculated effects of nonsphericity. *Massachusetts Institute of Technology, Solid-State and Molecular Theory Group, Progress Report No.* 31, Jan. 15, 1959, p. 4-21. (QC1 M38.7q Vis.)

7079 Mechanical Oscillation Theory. I. Simple Oscillators. Oscillation problems of mechanics in the closed form with practical applications are the object of this textbook for students and reference book for the physicist and engineer. Only the mechanical oscillations of classical mechanics are treated, thus the oscillations of the mass point, of the rigid body, of the liquids and gases. The differential equations and their solving methods are shown to be usable in the electric oscillation theory. (*In German.*) Mechanische Schwingungslehre. I. Einfache Schwinger. ***Max Schuler.*** 2nd Rev. Ed. 158 pp. 1958. Akademische Verlagsgesellschaft, Geest & Portig K.-G., Leipzig, Germany. (QA935 Sch81m2)

7080* On the Number of Fundamental Fields. With three massless Majorana fields one can get all additive constants but for getting also the multiplicative constants one has to double the number of fields. The consequences of a γ_5-invariance are studied for the 6-field case. ***W. Thirring Cern.*** *Nuclear Physics*, v. 10, no. 2, Feb. 1959, p. 97-106.

7081 Photoionization Analysis by Mass Spectroscopy. A vacuum ultraviolet monochromator has been combined with a mass spectrometer to study the above between 1570 and 430 A. Monochromatic photons were used to ionize A, He, Ne, O_2, N_2, CO, No, CO_2 N_2O, and NO_2. ***G. L. Weissler, J. A. R. Samson, M. Ogawa, and G. R Cook.*** *Optical Society of America, Journal*, v. 49, Apr. 1959, p. 338-349.

7082 Measurement of Optical Clarity by Low-Angle Scattering. Visual estimates of optical clarity correlate well with instrumental low-angle light scattering measurements via this instrument. ***Fred W. Billmeyer, Jr.*** *Optical Society of America, Journal*, v. 49, Apr. 1959, p. 368-371.

7083 Experimental Investigations of Exciton Spectra in Ionic Crystals. Three classes of line spectra have been observed. The spectra of two of the classes are in reasonable agreement with the predictions of recent theories of exciton spectra while those of the third class are most probably also exciton spectra of a type which has not yet been treated theoretically, but other interpretations are possible. ***S. Nikitine.*** *Philosophical Magazine*, v. 4, ser. 8, Jan. 1959, p. 1-31.

7084 The Photo Creation and Destruction of F Centres. Observes F centers formed within, and not at external surfaces of KCl crystals. Rate of creation by X-rays has been found. ***R. V. Hesketh.*** *Philosophical Magazine*, v. 4, ser. 8, Jan. 1959, p. 114-125.

7085 The Excitation of Molecular Vibration and Rotation by Impact of Slow Electrons. Considers the fact that in such impacts the incident electron is moving much faster than the nuclei in the molecule while its wave functions suffers considerable distortion by the molecular field. ***H. S. W. Massey.*** *Philosophical Magazine*, v. 4, ser. 8, Mar. 1959, p. 336-340.

7086 A Generalization of Grüneisen's Theory of Solids and Its Application to Solid Argon. The quasi-harmonic model of a solid is examined and a general notation established. ***R. O. Davies and S. Parke.*** *Philosophical Magazine*, v. 4, ser. 8, Mar. 1959, p. 341-358.

7087 Critical Field Measurements on Superconducting Lead Isotopes. The measurement of the isotope effect upon the superconducting critical field of lead has been extended from T_c to 1.28 K, and an accurate critical-field curve for lead is reported for this temperature range. The electronic specific heat in the superconducting state does not show an exponential $1/T$ dependence but instead a close resemblance to a T^3 dependence below 5 K. ***D. L. Decker, D. E. Mapother, and R. W. Shaw.*** *Physical Review*, v. 112, ser. 2, no. 6, Dec. 15, 1958, p. 1888-1898.

7088 Effect of a Magnetic Field on Thermionic Emission From Molybdenum. An experiment that was performed to explore the possible effect of an external magnetic field on thermionic emission from a clean metal surface demonstrated that an applied field of 6000 gauss or less has no effect on the saturation current density. The purpose of this study was to resolve, if possible, the disagreement between the work of Shelton and that of Nottingham and Hutson on the energy distribution of thermionically emitted electrons. ***Joel Greenburg.*** *Physical Review*, v. 112, ser. 2, no. 6, Dec. 15, 1958, p. 1898-1900.

7089 Random-Phase Approximation in the Theory of Superconductivity. A generalized approximation of the theory of Coulomb correlation energy is applied to the theory of superconductivity. ***P. W. Anderson.*** *Physical Review*, v. 112, ser. 2, no. 6, Dec. 15, 1958, p. 1900-1916.

7090 Infrared and Optical Masers. Shows that by using a resonant cavity of centimeter dimensions, having many resonant modes, maser oscillation at these wave-lengths can be achieved by pumping with reasonable amounts of incoherent light. ***A. L. Schawlow and C. H. Townes.*** *Physical Review*, v. 112, ser. 2, no. 6, Dec. 15, 1958, p. 1940-1949.

7091 Zeeman-Type Magneto-Optical Studies of Interband Transitions in Semiconductors. The selection rules, polarization effects, and the character of the absorption spectra for interband transitions in the presence of a magnetic field are discussed and illustrated by experimental data for Ge and InSb. ***E. Burstein, G. S. Picus, R. F. Wallis, and F. Blatt.*** *Physical Review*, v. 113, ser. 2, no. 1, Jan. 1, 1959, p. 15-33.

7092 Low-Temperature Luminescence and Photoconductivity of AgCl. The magnitudes and the decay processes of the above have been simultaneously investigated between 4 K and 210 K. ***Donald A. Wiegand.*** *Physical Review*, v. 113, ser. 2, no. 1, Jan. 1, 1959, p. 52-62.

7093 Acoustoelectric Effect. The equilibrium, the transport, and the phenomenological approaches are discussed. Describes three causes which have led to mutually conflicting conclusions. ***R. H. Parmenter.*** *Physical Review*, v. 113, ser. 2, no. 1, Jan. 1, 1959, p. 102-109.

7094 Total Cross Sections for Multiple Electron Stripping in Atomic Collisions at Energies to 100 kev. Helium$^+$, Ne^+, and A^+ ions in single collisions of He^+ on He, Ne, and A; Ne^+ on Ne and A; and A^+ on A were measured for electron capture and stripping. ***P. R. Jones, F. P. Ziemba, H. A. Moses, and E. Everhart.*** *Physical Review*, v. 113, ser. 2, no. 1, Jan. 1, 1959, p. 182-191.

7095 Invariants of General Relativity and the Classification of Spaces. A unique equivalence is established between the Riemann curvature tensor and two spinors. A classification of Einstein spaces is made together with a few additional remarks concerning classification of spaces. ***Louis Witten.*** *Physical Review*, v. 113, ser. 2, no. 1, Jan. 1, 1959, p. 357-362.

7096* Thermodynamic Foundation of the Theory of Plasma. Thermodynamics of irreversible processes is applied to dense plasmas in a weak magnetic field. Basic equations of "magneto-thermo-hydrodynamics" are derived together with relations between transport coefficients. ***Taro Kihara.*** *Physical Society of Japan, Journal*, v. 14, Feb. 1959, p. 128-133.

7097* Stress-Ordering Effect on Thermal Expansion of CuAu Single Crystals. Linear thermal expansion of CuAu single crystals was measured. When a barformed specimen was slowly cooled from above the transition temperature under compresssive stress along its longitudinal direction, it was confirmed that the *c*-axes of the ordered phase were predominantly lined up in one of the cubic axes nearest to the stress direction. Furthermore a linear relationship was established to hold between the compressive stress previously applied and the amount of the dilatometric change due to the order-disorder transition. However, even when some of the crystals were initially annealed free from external stress, the tetragonal *c*-axes were not distributed statistically along the three original cubic axes. ***Makoto Hirabayashi.*** *Physical Society of Japan, Journal*, v. 14, Feb. 1959, p. 149-152.

7098* On the Unstable States in Quantum Field Theory. Properties are studied in detail by making use of Lee's model. The renormalization procedure is proposed and the correspond-

ing Z-factor has values only between zero and unity. ***Tetsuo Gotō.*** *Progress of Theoretical Physics*, v. 21, no. 1, Jan. 1959, p. 1-17.

7099* Radiation During Flight of Charged Particles Near Ideally Conducting Surfaces. The general problem of the radiation of electromagnetic oscillations during the flight of charged particles in vacuum near ideally conducting surfaces is considered in the nonrelativistic approach. Formulas are derived for the radiation energy and spectrum. An exemplary problem of the excitation of oscillations during flight of electrons from the open semispace into a circular waveguide. (*In Russian.*) Izluchenie pri prolete zariazhennykh chastits vozle ideal'no provodiashchikh tel. ***Iu. N. Dnestrovskiĭ and D. P. Kostomarov.*** *Radiotekhnika Elektronika*, v. 4, no. 2, Feb. 1959, p. 303-312.

7100 Production and Measurement of Ultra-High Vacua. Residual gas pressures as low as 10^{-10} mm. Hg are obtained and measured by means of a combined ionization pump and gage. ***J. Dutton.*** *Research*, v. 12, Mar. 1959, p. 103-106.

7101 Submicrosecond High-Intensity Light Source. A short duration explosive light source yields an estimated luminosity of 8 x 10^7 lumens. ***Charles H. Bagley.*** *Review of Scientific Instruments*, v. 30, Feb. 1959, p. 103-104.

7102 High-Current Ion Source. Capable of producing an ion beam of ½ amp. The energy spread of the ions is large. ***Russell G. Meyerand, Jr. and Sanborn C. Brown.*** *Review of Scientific Instruments*, v. 30, Feb. 1959, p. 110-111.

7103 Use of Neon in Cryogenics. Shows that the cost of using liquid neon from 20 to 30 K is not prohibitive. A simple method of condensing the gas is described. ***J. F. Dillon, Jr. and V. Jaccarino.*** *Review of Scientific Instruments*, v. 30, Feb. 1959, p. 132-133.

7104 Absorption Measurements and Irradiations in the Cary and Beckman Spectrophotometers, at Low and High Temperatures. Attachments to the Cary recording spectrophotometer and the Beckman D. U. spectrophotometer which permit use of all-quartz optical cells from −170 to 200 C. ***Y. Hirshberg and E. Fischer.*** *Review of Scientific Instruments*, v. 30, Mar. 1959, p. 197-199.

7105* Experimental and Theoretical Investigations of the General Application of the Fabry-Perot Spectrometer to the Different Fields of Spectroscopy. V. Experimental Results. (*In French.*) Recherches expérimentales et théoriques sur la généralisation de l'emploi du spectromètre fabry-perot aux divers domaines de la spectroscopie. V. Réalisations expérimentales. ***Robert Chabbal.*** *Revue d'Optique Théorique et Instrumentale*, v. 37, nos. 10-11, Oct.-Nov. 1958, p. 501-551.

7106 On the Evaluation of Equivalent Debye Temperatures and Related Problems. Procedure is illustrated by the FCC metals Al, Ag, Au, Cu, and Pb. ***G. K. Horton and H. Schiff.*** *Royal Society, Proceedings*, v. 250, ser. A, Mar. 10, 1959, p. 248-265.

7107* Spherical Gravitational Waves. The field of gravitational radiation emitted from two moving particles is investigated by means of general relativity. A method of approximation is used, and in the linear approximation retarded potentials corresponding to spherical gravitational waves are introduced. ***W. B. Bonnor.*** *Royal Society of London, Philosophical Transactions*, v. 251, Ser. A. Mathematical and Physical Sciences, no. 994, Mar. 12, 1959, p. 233-271.

7108 Electroluminescence. A review indicating electroluminescence as a true frontier in science and technology, now being explored as a new development in solid-state physics and as a new and useful light source. ***K. H. Butler.*** *Science*, v. 129, Feb. 27, 1959, p. 544-550.

7109 Solid State Physics. Advances in Research and Applications. Suppl. I. Nuclear Quadrupole Resonance Spectroscopy. Explains the features of the quadrupole spectra, and to show how they are interpreted in terms of the electron distributions that produce the necessary electric field gradients at nuclei. The spectra will provide information concerning positions of molecules and ions in the crystalline unit cell and their motional behavior. ***T. P. Das and E. L. Hahn.*** 223 pp. 1958. Academic Press, New York. (QC125 So44)

7110 Structural Conversions in Crystalline Systems and Their Importance for Geological Problems. Experimental methods suitable for the systematic study of structural conversions are illustrated by a selection of examples taken from simple metal alloys, sulfides, and related ore minerals, halides, oxides, oxysalts, and silicates. Information on the important role which structural conversions play in the group of the silica minerals is given. ***Wilhelm Eitel.*** 183 pp. 1958. Geological Society of America, New York. (QD921 Ei92s)

7111 Topics in Electromagnetic Theory. Provides a logical, unified treatment of topics of interest in the field of electromagnetic theory and microwave electron tubes. Covers periodic transmission systems, propagation on a wire helix, concepts concerning coupling of modes of propagation, and anisotropic media and the waves that propagate therein. ***Dean A. Watkins.*** 118 pp. 1958. John Wiley & Sons, New York. (QC670 W32t)

7112 Free Oscillations of an Electron Plasma in a Magnetic Field. The presence of a magnetic field gives rise to anisotropy of the space. ***A. I. Akhiezer and L. E. Pargamanik.*** *U. S. Atomic Energy Commission, AEC-tr-*3492, 38 pp. (UF767 Un3.1ae Contin.) (Translated from *Uchenye Zapiski, Khar'kov. Gosudarst.* p. 75-104, 1948.)

7113 On the Instability of a Coasting Beam. The time-dependent Boltzmann equation is linearized about the stationary solution corresponding to a coasting beam of almost monoenergetic particles, to determine the effect of small density fluctuations. An integral equation is obtained, and solved, leading to a dispersion relation quite similar to that well known in the theory of plasma oscillations. ***C. E. Nielsen and A. M. Sessler.*** *U. S. Atomic Energy Commission, MURA-*441, Jan. 1, 1959, 18 pp. (UF767 Un3.1mu Contin.)

7114 Stability of Hydromagnetic Equilibria With Helically Invariant Fields. An equilibrium situation is obtained for the case of a uniform axial magnetic field with the addition of a superposition of weak helically invariant fields, a field due to a small axial current and a field due to a low pressure infinitely conducting plasma. The energy principle is used to determine conditions for the stability of this equilibrium. ***J. L. Johnson, C. R. Oberman, R. M. Kulsrud, and E. A. Frieman.*** *U. S. Atomic Energy Commission, NYO-*7904, Aug. 1, 1957, 181 pp. (UF767 U3ny Contin.)

7115 High Temperature Classical Equation of State. Studies the effect of potential perturbations on the equilibrium properties of a hard sphere system at both high and low densities. A comparison with experimental data shows the applicability of this perturbation from a hard sphere potential to the estimation of the equilibrium properties of a great variety of gases at moderately high temperatures. ***B. J. Alder and B. B. Smith.*** *U. S. Atomic Energy Commission, UCRL-*5412-T, Nov. 1958, 35 pp. (UF767 U3u Contin.)

7116 Analysis of the K^- Beam Transmitted by the Murray Spectrometer. ***John N. Dyer.*** *U. S. Atomic Energy Commission, UCRL-*8364 Suppl., Jan. 27, 1959, 5 pp. (UF767 U3u Contin.)

7117* Microscopy With X-Rays. Four methods are mentioned, the latest using the flying-spot technique. ***V. E. Cosslet.*** *World Science Review*, 1959, Mar., p. 16.

7118* A Resonance Phenomenon in Perminvar Ferrites Tempered in a Magnetic Field. This treatment results in the appearance of a great number of close comparatively low damped independent resonances in an unexpected frequency range. An attempt is made to explain this resonance on the basis of investigation data. (*In German.*) Ein Resonanzphänomen bei magnetfeldgetemperten Perminvarferriten. ***Helmut Rabl.*** *Zeitschrift für Angewandte Physik*, v. 11, no. 2, Feb. 1959, p. 57-63.

7119* Permitted and Forbidden Regions in the Movement of Electrically Charged Particles in Magnetic Fields of Rotational Symmetry. Diagrams are constructed of allowed and forbidden regions in the meridional plane and the boundaries are then transformed into straight lines. By the

example of the circular current it is shown how the problem of the so-called particle-loss can be attacked. (*In German.*) Erlaubte und verbotene Gebiete bei der Bewegung elektrisch geladener Teilchen in axial-symmetrischen Magnetfeldern. ***Von H. Fisser and R. Kippenhahn.*** *Zeitschrift für Naturforschung*, v. 14a, Jan. 1959, p. 37-46.

7120* Propagation of Superficial Electromagnetic Waves Along a Many-Wire System. At first the field of superficial waves was studied without any limitation considering the case when the wires are covered by thin electrical layers. The dispersion equation determining the spectrum of the number of the superficial waves propagated along the system is obtained in the form of a determinant of infinite order. (*In Russian.*) Rasprostranenie poverkhnostnykh elektromagnitnykh voln vdol' mnogoprovodnoĭ sistemy. ***N. A. Armand.*** Zhurnal Tekhnicheskoĭ Fiziki, v. 29, no. 1, Jan. 1959, p. 107-119.

See also: **6378** (chemical physics); **6442** (efficiency of a disk atomiser); **6556** (semiconductors).

PLASTICS

7121* Polycondensation of Glycine Ethyl Ester in the Presence of Its Carbamate. Studying carbamates as initiators of the polycondensation of the esters of α-aminoacids in the presence of carbon dioxide; kinetics of monomer consumption during the polycondensation. (*In Russian.*) Polikondensatsiia etilovogo efira glitsina v prisutstvii ego karbamata. ***K. T. Poroshin, Iu. I. Khurgin, and T. D. Kozarenko.*** *Akademiia Nauk SSSR, Doklady*, v. 124, no. 1, Jan. 1, 1959, p. 105-106.

7122* On Heterogeneous Chain Polyesters. XII. Polyesters of Azobenzene-3,3′- and Azobenzene-4,4′-dicarboxylic Acids. XIII. Polyesters of *p*-Xylylene Glycol. (*In Russian.*) O geterotsepnykh poliefirakh. XII. Poliefiry azobenzol-3,3′- i azobenzol-4,4′-dikarbonovoĭ kisloty. XIII. Poliefiry *p*-ksililenglikolia. ***V. V. Korshak and S. V. Vinogradova.*** *Akademiia Nauk SSSR, Izvestiia, Otdelenie Khimicheskikh Nauk*, 1959, no. 1, Jan., p. 148-161.

7123* Synthesis and Transformations of Vinyl Ethers of Ethanolamines. X. Free Radical Polymerization and Copolymerization of Trivinyl Ether of Triethanolamine. XI. Some Features of the Copolymerization of Vinyl Ether of β-Aminoethanol and Methyl Ester of Methacrylic Acid. (*In Russian.*) Sintez i prevrashcheniia vinilovykh efirov etanolaminov. X. Svobodnoradikal'naia polimerizatsiia i sopolimerizatsiia trivinilovogo efira trietanolamina. ***M. F. Shostakovskiĭ and I. A. Chekulaeva.*** XI. Ob osobennostiakh sopolimerizatsii vinilovogo efira β-aminoetanola i metilovogo efira metakrilovoĭ kisloty. ***M. F. Shostakovskiĭ, V. A. Gladyshevskaia, and I. A. Chekulaeva.*** *Akademiia Nauk SSSR, Izvestiia, Otdelenie Khimicheskikh Nauk*, 1959, no. 1, Jan., p. 130-139.

7124 Equilibrium Polymerization of Sulfur. A simple and unified theory describes the ring-chain equilibrium over the entire liquid range of sulfur. ***Arthur V. Tobolsky and Adi Eisenberg.*** *American Chemical Society, Journal*, v. 81, Feb. 20, 1959, p. 780-782.

7125 The Thermal Reaction of Styrene With Ethyl Thioglycolate; Evidence for the Termolecular Thermal Initiation of Styrene Polymerization. ***Richard R. Hiatt and Paul D. Bartlett.*** *American Chemical Society, Journal*, v. 81, Mar. 5, 1959, p. 1149-1154.

7126 Cross-Linking of Polymers With Dimaleimides. Chemistry of the cross-linking processes. ***Peter Kovacic and Richard W. Hein.*** *American Chemical Society, Journal*, v. 81, Mar. 5, 1959, p. 1187-1190.

7127 Cross-Linking of Unsaturated Polymers With Dimaleimides. In the presence of catalytic amounts of dicumyl peroxide, dimaleimides functioned as highly effective cross-linking agents for natural rubber and GR-S. Chemistry of the cross-linking process is discussed, and correlations are drawn between the structure of the dimaleimide and vulcanizate properties. ***Peter Kovacic and Richard W. Hein.*** *American Chemical Society, Journal*, v. 81, Mar. 5, 1959, p. 1190-1194.

7128* Thermal Degradation of Polymeric Phosphorus Nitrile Chloride. The depolymerization strictly obeys the first order gross reaction law. Gross activation energies of polymerization and depolymerization are compared. (*In German.*) Über den thermischen Abbau des polymeren Phosphornitrilchlorids. ***F. Patat and P. Derst.*** *Angewandte Chemie*, v. 71, no. 3, Feb. 7, 1959, p. 105-110.

7129* Tooling in Plastics. Determination of the suitability of plastics in tooling. Properties of epoxide resin tooling compositions. ***P. G. Pentz.*** *Applied Plastics*, v. 2, Jan. 1959, p. 19 + 5 pages.

7130* Applications of Plastic Mouldings. Phenolic, urea formaldehyde, melamine formaldehyde, polystyrene, polythene, nylon, cellulose acetate, PVC, and acrylic molding applications; typical molding methods. *Applied Plastics*, v. 2, Feb. 1959, p. 14 + 7 pages.

7131* Plastics in the Chemical Industries. III. Polyvinyl Chloride. Properties and applications of polymerized vinyl chloride. *Applied Plastics*, v. 1, Mar. 1958, p. 20-28.

7132 C-oil, a New Hydrocarbon Thermosetting Resin for Reinforced Plastics. Deals with a liquid copolymer of butadiene and styrene in the approximate weight ratio of 80/20. Results of preliminary studies on the fabrication and curing of several types of reinforced materials using this resin. ***H. Clark and B. M. Vanderbilt.*** *British Plastics*, v. 32, Feb. 1959, p. 69-71.

7133 High Molecular Weight Plasticizers for P.V.C. Discusses losses from PVC systems into solid and liquid media both of high molecular weight type plasticizers and the simple low molecular weight esters, as exemplified by alkyl phthalates and sebacates and aryl phosphates; the controlling factors involved and results obtained. ***Allan Hill.*** *British Plastics*, v. 32, Feb. 1959, p. 74 + 4 pages.

7134 Plastic Doesn't Rip. Grid of fiber strands laminated between two plastic films provides rip-stop action. *Chemical and Engineering News*, v. 37, no. 10, Mar. 9, 1959, p. 79-81.

7135 How to Fix Polymer Molecules in Space. Stereospecific polymerization. ***Frank X. Werber and Donald F. Hoeg.*** *Chemical and Engineering News*, v. 37, no. 12, Mar. 23, 1959, p. 58 + 7 pages.

7136 New Look for Epoxy Plastics—With Diepoxides. Properties, availability, and uses of Epoxide 201, vinylcyclohexene dioxide, and dicyclopentadiene dioxide. *Chemical Processing*, v. 22, Mar. 1959, p. 57-58.

7137* Stereospecific Polymerization of Styrene. V. Temperature Effects With Catalysts From $Al(C_2H_5)_3$ and $TiCl_4$. Temperature conditions were determined, to reach the highest activities and to increase catalyst stability during the course of polymerization. An activation energy of 10,500 cal $mole^{-1}$ was calculated for the over-all process, likely to be uniquely attributed to the polymerization reaction. (*In Italian.*) Polimerizzazione stereospecifica dello stirolo. V. Effetti di temperatura con catalisi da $Al(C_2H_5)_3$ e $TiCl_4$. ***F. Danusso, B. Calcagno, and D. Sianesi.*** *Chimica e l'Industria*, v. 41, Jan. 1959, p. 13-18.

7138* Mode of Formation and Structure of Macropolymer Films. Application to Nitrocellulose. A study of the changes occurring in the structure of the films during their formation, especially in relation to drying speed, nature of the solvent, plasticizer. (*In French.*) Mode de formation et structure des films de macropolymères. Application à la nitrocellulose. ***Meffroy-Biget.*** *Journal de Chimie Physique*, v. 56, Jan. 1959, p. 35-40.

7139* Degradation Studies of Polyethylene Terephthalate. Rates of hydrolysis, oxidation, and thermal degradation of polyethylene terephthalate were studied as functions of temperature, relative humidity, and film thickness. ***William McMahon, H. A. Birdsall, G. R. Johnson, and C. T. Camilli.*** *Journal of Chemical and Engineering Data*, v. 4, no. 1, Jan. 1959, p. 57-79.

7140* Some Anhydride Curing Agents for Epoxy Resins. ***F. W. Michelotti, C. J. Knuth, and A. Bavley.*** *Journal of Chemical and Engineering Data*, v. 4, no. 1, Jan. 1959, p. 79-82.

7141* Effect of Temperature on Properties of Aqueous Dispersions of Poly (Vinyl Methyl Ether)-Maleic Anhydride Half Amide. The temperature-viscosity relationship of poly-(vinyl methyl ether)-maleic anhydride half amide copolymer dispersions was investigated. ***Arthur P. Harrison.*** *Journal of Chemical and Engineering Data*, v. 4, no. 1, Jan. 1959, p. 83-85.

7142* Effects of Blending on the Stress-Relaxation Behavior of Polyvinyl Acetate in the Rubbery Region. Experimental study of the interaction effects on the stress-relaxation behavior of polyvinyl acetate blends. ***Kazuhiko Ninomiya.*** *Journal of Colloid Science*, v. 14, no. 1, Feb. 1959, p. 49-58.

7143* Hostalit Z—A New PVC Compound. A new polyblend based on PVC and a chlorinated polyolefin. Compounds available range from rigid, high-impact strength materials to soft and flexible products. The mechanical, thermal, and electrical properties of these compounds are described, as well as their resistance to solvents and chemicals and their processing characteristics. (*In German.*) Hostalit Z, ein neuer Kunststoff auf PVC-Basis. ***Hans-Helmut Frey.*** *Kunststoffe*, v. 49, Feb. 1959, p. 50-55.

7144* Liquid Polysulfide Polymers. Liquid thiokols are obtained by reacting dichlordiethyl formal with sodium polysulfide. They were developed from the solid polysulfides which are made by reacting dichlorethylene with an alkali polysulfide. (*In German.*) *Flüssige Polysulfid-Polymere.* ***Günther Göbel.*** *Kunststoffe*, v. 49, Feb. 1959, p. 56-58.

7145* Recent Developments in Resins and Glass Fiber for Reinforced Plastics. Developments in basic materials used for reinforced plastics, as well as in the methods used for their processing and application. (*In German.*) Neuere Harze und Fasern für Glasfaserkunststoffe. ***Harro Hagen.*** *Kunststoffe*, v. 49, Feb. 1959, p. 59-62.

7146 Polyester Film—How Long Does It Last? Curves are given for determining the length of time Mylar-type polyester film can be used at various temperatures and humidities. ***W. McMahon, H. A. Birdsall, G. R. Johnson, and C. T. Camilli.*** *Materials in Design Engineering*, v. 49, Feb. 1959, p. 94-95.

7147 Engineer's Guide to Plastics. A concise outline of a complex field, this manual tells what kinds of materials you can buy, their outstanding properties, and where they're used. ***Malcolm W. Riley.*** *Materials in Design Engineering*, v. 49, Feb. 1959, p. 103-118.

7148* Nylon 6, Now a Packaging Film. With new processing techniques having been developed, this film is now of interest to users of packaging materials. Chemical and physical properties, heat-sealability, and suggested uses are discussed. ***Bruce M. Miller.*** *Package Engineering*, v. 4, Mar. 1959, p. 62 + 3 pages.

7149 Crosslinking Processes in Relation to Some Physical Properties of Polymers. I. A discussion of scission processes. ***H. S. Lilley.*** *Paint Technology*, v. 23, Feb. 1959, p. 51-57.

7150* Impact Bending Strength Measurements of Polystyrene as a Function of Speed and Temperature. (*In German.*) Schlagbiegefestigkeitsmessungen an Polystyrol in Abhängigkeit von Geschwindigkeit und Temperatur. ***A. Borgwardt.*** *Plaste und Kautschuk*, v. 6, Feb. 1959, p. 68-70.

7151 The Induction of Electrical Conductivity of Irradiated Polymers. Effects of high energy radiations on polymers; survey of the literature dealing with induced electrical conductivity in irradiated plastics. ***L. Holland.*** *Plastics (London)*, v. 24, Mar. 1959, p. 112-114.

7152* Environmental Stress-Cracking Resistance of High-Density Polyethylene. Factors influencing environmental stress-cracking of injection-molded linear polyethylene are discussed. ***F. H. McTigue.*** *Plastics Technology*, v. 5, Feb. 1959, p. 35-39.

7153* Resin Characteristics Relating to Laminate Behavior. Mechanical properties of glass-reinforced laminates are shown to depend on resin properties and conditions of loading. ***F. N. McGarry.*** *Plastics Technology*, v. 5, Feb. 1959, p. 44-48.

7154* Optical Properties of Translucent, Glass-Reinforced Panels. Results of an investigation of sheet made from unsaturated polyester resin containing acrylic monomers. ***Daniel Smith and J. B. Crenshaw.*** *Plastics Technology*, v. 5, Mar. 1959, p. 42-49.

7155* Developments in Plastic Materials-1958. Review of highlights in plastics. ***Gordon B. Thayer.*** *Plastics Technology*, v. 5, Mar. 1959, p. 55-58.

7156* Polycarbonates. Production, mechanical properties, electrical properties, chemical resistance, processing, and applications. *Rubber and Plastics Age*, v. 40, Feb. 1959, p. 150-151.

7157* Pitfalls in Evaluation of PVC Stabilizers. Rules for testing vinyl stabilizers, developed through long experience; careful analysis of each step presented here should result in superior quality and reduced cost. ***Charles H. Fuchsman.*** *SPE Journal*, v. 15, Mar. 1959, p. 214 + 2 pages.

7158* Castable Conductive Plastics. Commercial polyester resins filled with ammonium perchlorate and graphite produce a series of combustible conductive plastic materials. ***William C. Tanner.*** *SPE Journal*, v. 15, Mar. 1959, p. 216-219.

7159* Fabricating Silicon Laminates to Get the Most Strength. The most important factor in determining the strength of low-pressure silicone laminates at both high and low temperatures is the completeness of cure. Other fabricating variables analyzed as to their effect on laminate strength include: manufacturing source of the glass fabric, number of plies on the laminate, catalyst concentration, resin pickup, precure time, precure temperature, press temperature, laminating pressure and time, and postcure time and temperature. ***L. W. Breed, Howard Christie, Calvin Bolze, Fred Baiocchi.*** *SPE Journal*, v. 15, Mar. 1959, p. 220-224.

7160* Preparing Vinyl α-ω-Difunctional Polymers by Anionic Polymerization in Homogeneous Phase. (*In French.*) Préparation de polymères vinyliques α-ω-difonctionnels par polymérisation anionique en phase homogène. ***P. Rempp and M. H. Loucheux.*** *Société Chimique de France, Bulletin*, 1958, nos. 11-12, Nov.-Dec., p. 1497-1501.

7161* Factors Influencing the Performance of Melamine Laminating Resins. The resin is described in terms of the approximate degree of polymerization, and this factor is correlated with the dilutability or water tolerance of the resin. Additives or modifiers are discussed with reference to their effect on flow, shrinkage, and hardness at elevated temperatures. ***H. P. Ledden and I. H. Updegraff.*** *Tappi*, v. 42, Feb. 1959, p. 165-168.

7162* The Co-polymerization of Vinyl Chloride With Styrene and Pentachlorostyrene. With a pentachlorostyrene content in the initial mixture of 0.08–0.1 molar fractions, a minimum in the rate is observed. The reactivity of pentachlorostyrene is less than that of styrene, which follows from the values of the copolymerization constants of vinyl chloride with styrene and pentachlorostyrene, correspondingly equal to $\alpha = 0.045$, $\beta = 12.4$; $\alpha = 0.43$, $\beta = 5.3$. (*In Russian.*) Sovmestnaia polimerizatsiia khloristogo vinila so stirolom i pentakhlorstirolom. ***G. V. Tkachenko, V. S. Etlis, L. V. Stupen', and L. P. Kofman.*** *Zhurnal Fizicheskoi Khimii*, v. 33, no. 1, Jan. 1959, p. 25-31.

See also: **6124** (plastics for aircraft structures); **6242** (plastics applications in chemurgy); **6384** (polytetrafluoroethylene); **6473** (plastisol and organosol metal coatings); **6700** (softening point measurement).

POLLUTION AND WASTES

7163* Some Effects of Air Pollutants on the Growth and Productivity of Plants. Fumigation with ozonated hexene caused repression in growth of bean plants. Leaves of fumi-

gated plants failed to enlarge as much as control leaves. On treated plants primary leaves aged and were lost prematurely, stems had a higher water content. ***Glenn W. Todd and Morris J. Garber.*** *Botanical Gazette*, v. 120, no. 2, Dec. 1958, p. 75-80.

7164* Fallout of Strontium 90 on the Earth Surface. A study of the origin of the fallout and of the special part played by strontium 90 among the products of fission. (*In German.*) Die Ablagerung von Strontium 90 auf der Erdoberfläche. ***Hans Kiefer and Rupprecht Maushart.*** *Naturwissenschaften*, v. 46, no. 3, Feb. 1959, p. 102-104.

7165* Development of the Anaerobic Contact Process. I. Pilot-Plant Investigations and Economics. A determination of parameters usable in designing and operating a large scale installation for industrial wastes and sewage, and an investigation of the basic actions involved in the anaerobic contact process. ***George J. Schroepfer and Norman R. Ziemke.*** *Sewage and Industrial Wastes*, v. 31, Feb. 1959, p. 164-190.

7166* Treatment of Wastes From Tall Oil Refining. A full-scale plant was satisfactorily designed with a limited amount of waste sample and closely controlled laboratory studies. ***B. W. Dickerson, W. T. Laffey, and R. O. McNeil.*** *Sewage and Industrial Wastes*, v. 31, Feb. 1959, p. 191-204.

7167 Techniques for Exposure of Mice to Aerosols of Radioactive Particles. ***D. H. Willard, W. J. Blair, L. A. Temple, and V. H. Smith.*** *U. S. Atomic Energy Commission, HW*-52368, Nov. 1, 1958, 22 pp. (UF767 Un3.1hw Contin.)

See also: **6287** (disposal of F).

RUBBER AND ELASTOMERS

7168 X-Ray Diffraction Measurement of Radiation Damage in Stretched Rubber. Study of extreme sensitivity of stretched rubber to radiation. ***Wesley E. Shelberg and Lewis H. Gevantman.*** *Nature*, v. 183, Feb. 14, 1959, p. 456-457.

7169* Recent Developments in Synthetic Foam Latex. Explains preparation of a latex with a high solid content and low viscosity. Freezing and unfreezing the latex under strictly defined conditions, yields a latex agglomerate with interesting characteristics and usable in the fabrication of sponge rubber. Consumption of this agglomerate in the U. S., Canada, the U. K., and France is studied. ***T. E. Dunfield, W. H. Watson, and F. L. White.*** *Revue Générale du Caoutchouc*, v. 36, Jan. 1959, p. 86-89.

7170* Evaluation of Grades of Mica as Fillers for Latex Foam Rubber. Basic formulation and process; compression modulus and hardness index; volume shrinkage; compression flexing test; tensile strength and elongation at break. *Revue Générale du Caoutchouc*, v. 36, Jan. 1959, p. 90.

7171* Production of Crystalline 1-4-*trans*-Polybutadiene and Polyisoprene and the Study of Their Properties. It is possible to obtain regularly constructed 1-4 trans-polymers of butadiene and isoprene with the combined effects of oxide catalysts, in particular chromium oxides, and aluminum silicate. (*In Russian.*) Poluchenie kristallicheskikh 1-4-trans-polibutadiena i-poliizoprena i izuchenie ikh svoĭstv. ***E. I. Tiniakova, B. A. Dolgopolsk, A. I. Mareĭ, and M. Z. Al'tshuler.*** *Akademiia Nauk SSSR, Doklady*, v. 124, no. 3, Jan. 21, 1959, p. 595-597 + 1 plate.

7172* A Contribution to the Study of the Vulcanization of High Elastic Polymers. XXIV. The Effect of Fillers on the Course of Vulcanization Reactions. I. A study of the effect of aerosil (SiO_2 filler) on the chemical reactions occurring during "thiuram" vulcanization and on their kinetics. Aerosil considerably increases the reaction rate. (*In German.*) Zur Kenntnis der Vulkanisation hochelastischer Polymerisate. XXIV. Der Einfluss von Fullstoffen auf den Verlauf von Vulkanisations-Reaktionen. I. ***Walter Scheele, Günter Mau, and Gregor Kemme.*** *Kautschuk und Gummi*, v. 12, Feb. 1959, p. WT33-WT36.

7173* Recent Studies of the Mixing Processes and Dispersion of Activated Carbon Blacks in Natural Rubber. Satisfactory dispersions were obtained in the normal mixing cycle with carbon blacks ISAF, HAF, and CK3. Stearic acid added during the rubber mastication led to a remarkable improvement in dispersion. (*In German.*) Neuere Arbeiten über Misch-Verfahren und Dispersion von Aktivrussen in Naturkautschuk. ***H. Westlinning.*** *Kautschuk und Gummi*, v. 12, Feb. 1959, p. WT41-WT46.

7174* New Developments in Elastomers. Symposium held by the Southern Rubber Group. Reports given on polyurethanes, fluoroelastomers, *cis*-polybutadiene elastomers, silicone rubber, and special purpose silicone polymers. *Rubber Age*, v. 84, no. 6, Mar. 1959, p. 959-977.

7175* Trends in Rubber Research. Forecasts based on an effort to apply basic principles of polymer science to the requirements for synthetic rubbers. ***A. V. Tobolsky.*** *Rubber World*, v. 139, no. 6, Mar. 1959, p. 857 + 6 pages.

7176* Wing-Stay 100 as an Antioxidant and Antiozonant. I. Wing-Stay 100 was designed to overcome the difficulties of using diphenyl-*p*-phenylenediamine. It consists of a mixture of diaryl-p-phenylenediamines with a melting point between 93 and 105 C. ***R. B. Spacht, W. S. Hollingshead, and J. G. Lichty.*** *Rubber World*, v. 139, no. 6, Mar. 1959, p. 863-868.

See also: **6316** (identification of carbon blacks); **7126** (crosslinking); **7127** (crosslinking).

SPACE HEATING AND CONDITIONING

7177 Five Defrost Methods for Commercial Refrigerators. ***J. H. Rainwater.*** *ASHRAE Journal*, v. 1, Mar. 1959, p. 61 + 6 pages.

7178 Transient Refrigeration Loads as Related to Energy-Flow Concepts. The effect of transient refrigeration loads is explored, specifically with regard to the storage-structure space and the immediately associated heat-exchanger equipment. Analogy methods using rheo-electric simulation techniques are used. ***Carl F. Kayan and John A. McCague.*** *ASHRAE Journal*, v. 1, Mar. 1959, p. 77-82.

7179 Surface Odor Adsorption and Retention Properties Measured. Results of a study to find a suitable method of measuring odor adsorption and retention characteristics of surfaces are discussed. ***W. F. Hopper.*** *ASHRAE Journal*, v. 1, Mar. 1959, p. 92-96.

7180* Environmental Control for Producing Ball Bearings. Ventilation, air cleaning and refrigeration systems installed at plant to provide proper air conditions for tolerance control, rust prevention on bearings, and air cleanliness. ***William A. Loumas and Edward C. Shepard.*** *Air Conditioning, Heating, and Ventilating*, v. 56, Mar. 1959, p. 69-70.

7181* Air Conditioning Bowling Centers. This is an extensive article for the engineer who wants information on how to air condition bowling centers, the systems that may be considered, and factors that govern their selection. ***Eugene L. Valerio.*** *Air Conditioning, Heating, and Ventilating*, v. 56, Mar. 1959, p. 75-81.

7182* Gas vs. Electric Air Conditioning. ***E. R. Ambrose.*** *Air Conditioning, Heating, and Ventilating*, v. 56, Mar. 1959, p. 92-93.

7183* New Data on Infra-Red Heating. It has been demonstrated in Germany that standard heat-loss estimates tend to produce oversized installations. *Air Conditioning, Heating, and Ventilating*, v. 56, Mar. 1959, p. 93.

7184 American Society of Heating and Air-Conditioning Engineers, Transactions (Annual Volume). Papers given at the 64th annual meeting, Pittsburgh, Pa., Jan. 27-29, 1958 and semi-annual meeting, Minneapolis, Minn., June 23-25, 1958. v. 64, 540 pp. 1958. American Society of Heating and Air-Conditioning Engineers, New York. (TH7201 Am35t Vis.)

7185* Why Heat Pump Is Your Best Bet. Customer satisfaction of heat pump owners is generally high, especially where customers have used other methods of space heating at higher costs. ***Reid Gardner.*** *Electrical World*, v. 151, Mar. 16, 1959, p. 62 + 1 page.

7186 Foundry Noise Manual. Deals with the legal aspects of the noise problem presently confronting all industry; explains in simple terms the scientific principles involved in noise control; describes the effects of noise on hearing; and offers practical solutions for controlling foundry noise. 50 pp. 1958. American Foundrymen's Society, Des Plaines, Ill. (TS233 Am35f Over.)

7187* Heating Britain's Largest Office Block. Bucklersbury House in London, houses 4000 persons in 9 controlled heating zones. *Fuel Efficiency*, v. 7, Feb. 1959, p. 13 + 2 pages.

7188* Soil Warming Saves Air Heating Costs in Greenhouses. *Fuel Efficiency*, v. 7, Feb. 1959, p. 17.

7189* The Use of Solar Energy in the U. K. Gives an interesting history and status report with both economic and technical considerations. ***H. Heywood.*** *Institute of Fuel, Journal*, v. 32, Mar. 1959, p. 110-112.

7190* Decentralized Cooling Eases 3-Step Growth Plan. N.J.'s Bergen Mall shopping-center tenants supply own cooling means; Mall provides steam. Result: minimum cooling headaches while center expands. ***J. E. Welker.*** *Power*, v. 103, Mar. 1959, p. 62-64.

7191* Why Waste Heat? Both sides of compressors are put to work to end tug-of-war between refrigeration and heating system in a supermarket. ***Paul M. Sturges.*** *Power*, v. 103, Mar. 1959, p. 89.

See also: **6264** (radiant heating installations); **6672** (space heating from Diesel heat).

TEXTILES, FIBERS, LEATHER, AND PAPER

7192* A Progress Report on the Enzyme Depilation of Cattle Hides. Nine enzyme preparations, selected for depilatory activity from a recently surveyed group of 40, are compared as to their ability to act upon casein, starch, and gelatin. Their comparative hair-loosening ability is also reported. Some special equipment is described. Results showing the direction of penetration of enzymes into hides and skins are given. The effects of concentration, pH, and temperature on hair loosening by one enzyme preparation are reported. ***Theone C. Cordon, W. Windus, I. D. Clarke, and J. Naghski.*** *American Leather Chemists Association, Journal*, v. 54, Mar. 1959, p. 122-139.

7193* Culture of Pine Root Callus and the Use of *Pinus clausa* Callus in Preliminary Metabolic Studies. The cultures were established and maintained by serial transfer. Tests revealed inhibition of respiration by cyanide, iodoacetic acid, and fluoride in solutions of pH 5.4. Polyphenol oxidase, peroxidase, and catalase activities were demonstrated in tissue extracts. Malate and aspartate were detected chromatographically as the initial products accumulating label in the dark from C^{14} O_2. ***Robert L. Barnes and Aubrey W. Naylor.*** *Botanical Gazette*, v. 120, no. 2, Dec. 1958, p. 63-66.

7194 Some Australian Research on Wool. I. Structure and Chemistry of Wool. An outline of research on wool root and associated structures, cortical cells and cuticle, fibrils, microfibrils, and proteins in the intact fiber, proteins extracted from wool, amino acid composition and chemical reactivity of wool. ***F. G. Lennox.*** *Research*, v. 12, Mar. 1959, p. 82-90.

7195* A Note on the Structure of Microfibrils in Native Cell Walls. On the inner surface of native lignified cell walls there were found structures consisting of irregularly distributed broadened and narrow areas. It is presumed that these are initial formations of cellulose microfibrils or of their simple bundles, originating probably by polymerization of simple glucides, present in very low concentrations in the protoplasm. The broadened areas are considered as accumulated hemicelluloses or low crystalline cellulose. ***V. Nečesaný.*** *Svensk Papperstidning*, v. 62, no. 3, Feb. 15, 1959, p. 73-76.

7196* Rheological Interpretation of the Mechanism of Crease Recovery of Fiber. The relationship between crease angle of fiber, temperature, and creasing time is discussed theoretically and experimentally. ***Hiroshi Sobue and Kenkichi Murakami.*** *Textile Research Journal*, v. 29, Mar. 1959, p. 251-260.

See also: **6158** (biological control of insect pests); **6277** (sulphite methods progress); **6280** (Kappa correction coeffiicent); **6464** (spectrophotometric evaluation of colorants).

WELDING AND JOINING

7197 Accelerated Aging Tests and Life Aging Properties of Aircraft Metal Adhesives. Tests based on engineering experience at Convair have been described. Due to rapid advances in the aircraft adhesive field, new test methods must constantly be devised to keep pace with the new applications found for these adhesives. ***J. P. Thomas.*** *ASTM Bulletin*, no. 235, Jan. 1959, p. 58-63.

7198 Ray Guns for Welding Go Commercial. Electron-beam welding is moving out of the laboratory. Two companies have already reached the point of marketing the equipment for commercial applications. Both Carl Zeiss of Western Germany and Stauffer-Temescal Corp. of Richmond, Calif., claims the process solves many of the problems associated with the growing family of Space Age metals and alloys, especially contamination problems. *American Machinist*, v. 103, Feb. 23, 1959, p. 94.

7199 Electrons Shot From Guns Make High-Purity Welds. The process operates in a very high vacuum. The heat for welding is produced by bombarding the surface of the workpiece with a concentrated beam of fast-moving electrons. The development effort by Bettis has been devoted primarily to making welds in zircaloy-2, a zirconium-base alloy with 1½% tin and small additions of chromium and nickel. ***George Burton and R. L. Matchett.*** *American Machinist*, v. 103, Feb. 23, 1959, p. 95-98.

7200* Resins for Chipboard and Hardboard. A brief review. *Applied Plastics*, v. 1, May 1958, p. 27.

7201 Effect on Fatigue Strength of Internal Defects in Welded Joints. A survey of the literature examines the present knowledge of the influence of defects in butt welds in mild steel plate, since this is considered to be the most important field for immediate research. ***R. P. Newman.*** *British Welding Journal*, v. 6, Feb. 1959, p. 59-64.

7202 Presentation of Fatigue Test Results. It is shown how simple statistical methods can be used in the presentation of the results of fatigue tests. Three ranges of stress cycles are considered. An example is given of graphical representation on a Wöhler diagram. ***J. Strebelle.*** *British Welding Journal*, v. 6, Feb. 1959, p. 65-71.

7203 Effect of Welding and Stress Relief on the Parent Plate. The mechanical properties of the heat-affected zone of a welded plate are compared with those of the parent plate; for mild steel, notch-ductile steel, and low-alloy high-strength weldable steels. The properties of the heat-affected zone are equal to those of the parent plate, provided that there is no cracking, or excessive hardening which may lead to cracking. ***J. E. Roberts.*** *British Welding Journal*, v. 6, Feb. 1959, p. 72-81.

7204 Niobium in Stainless Steel Weld Metal. The effect of up to 3% niobium on the structure and mechanical properties of welds in 18/8 type austenitic steel was investigated in the as-welded state and after water-quenching, 'stabilizing-annealing', and heating at 650 C for 1000 hr. ***C. G. Mukhin and***

N. Y. Palchuk. *British Welding Journal*, v. 6, Feb. 1959, p. 82-86. Translated from *Avtomaticheskaia Svarka* ("Automatic Welding"), no. 2, 1957.

7205 Determination of Total Hydrogen Contents in Weld Metal. Parallel testing of one low-hydrogen and one rutile type weld metal specimen was arranged in three laboratories: Murex Welding Processes Ltd. (Great Britain), British Welding Research Association (Great Britain), and SINTEF (Norway). *British Welding Journal*, v. 6, Feb. 1959, p. 87-89.

7206 Easier Hard-Facing. A new method of applying hard-facing alloys which they call the sprinkle-fuse process. Greatest benefit is to be derived from this new method when facing large numbers of small articles such as valve seatings, seat rings and discs, pump sealing rings and thrust plates, when induction heating offers the advantages of automatic heat control, reduction in heating times, and elimination of welding skill. *Engineering*, v. 187, Feb. 13, 1959, p. 209.

7207* How to Weld 2 7/16-Inch Thick Stainless-Clad Mn-Mo Steel. Two different welding processes and three different types of electrodes are used in fabricating high pressure tanks. *Industry & Welding*, v. 32, Mar. 1959, p. 27 + 1 page.

7208* High-Speed Fabrication of 120 Ft. Girders. Stemming from a long-run task of producing fabricated structural steel girders for bridges on Ohio's Conneaut-to-Cincinnati freeway, the system described proves that such gigantic weldments can be made on a production line. *Industry & Welding*, v. 32, Mar. 1959, p. 28-30.

7209* Automatic Welds Spheres From the Inside. It is now possible to weld spheres (and cubes) in thickness up to ½-inch automatically from the inside. *Industry & Welding*, v. 32, Mar. 1959, p. 31 + 1 page.

7210* Automatic Fixturing Is the Key to Precision Welding and Soldering. Engineered assembly line with conveyor and automatic fixturing for induction soldering and projection welding makes possible top quality, high volume production. *Industry & Welding*, v. 32, Mar. 1959, p. 36 + 2 pages.

7211 Inert-Gas Metal-Arc Welding for Aluminium Sheet and Strip. The T.I.G. (tungsten inert gas) process has found most application in sheet metal work. For the welding of material thicker than ⅛ in., the more recently introduced inert-gas metal-arc process, or "M.I.G." (metal inert-gas) process, which uses a consumable bare wire electrode, is generally preferred. ***J. E. Tomlinson.*** *Light Metals*, v. 22, Mar. 1959, p. 73-76.

7212 High-Frequency Resistance Welded Tubes. This new method of manufacturing aluminum tube from coiled strip offers many useful advantages and may prove competitive even with steel tube. *Light Metals*, v. 22, Mar. 1959, p. 94-95

7213 Adhesive Bonding of Titanium. Two of the many problems that have tended to slow the development of adhesive-bonded titanium structures are: 1) the unavailability of adhesives that can be used at elevated temperatures for long periods of time, and 2) the unavailability of suitable surface treatments to prepare titanium for bonding. In addition, the use of titanium core materials will necessitate some changes in manufacturing techniques and tools used in adhesive bonding. Adhesive blends are best but they do not solve all problems. The adhesive blends are combinations of thermoplastic, thermosetting and elastomeric adhesives which are formulated to obtain the optimum characteristics of each type. The more important adhesive blends are listed in an accompanying box. The most promising of the presently available adhesives are modified phenolic-epoxy resins. Much effort, however, is being exerted to develop high temperature ceramic, organic and semi-organic adhesives. ***H. E. Pattee, G. E. Faulkner, and P. J. Rieppel.*** *Materials in Design Engineering*, v. 49, Feb. 1959, p. 96-99.

7214* The Weldable Aluminum Alloys. Modern welding techniques, plus the continuing improvement of weldable aluminum alloys with superior mechanical properties, have been important factors in the growth of aluminum as a structural material. *Modern Metals*, v. 15, no. 1, Feb. 1959, p. 40 + 4 pages.

7215 Serviceability of Welds Containing Discontinuities. The effects of porosity on the mechanical properties of mild-steel welds. ***William L. Green.*** *News in Engineering at Ohio State University*, v. 31, no. 1, Feb. 1959, p. 13 + 4 pages.

7216 Influence of the Peltier Effect in Resistance Welding. During tests on a spot-welding machine for the fabrication of grids for radio valves, the direction of current flow was found to have a marked influence on the strength of the weld. This phenomenon can be explained by assuming it to be due to the Peltier effect. ***T. C. Balder.*** *Philips Technical Review*, v. 20, no. 7, Feb. 1959, p. 188-192.

7217 11 Ways to Couple Tubes. An assortment of mechanical joints, including clamps, screws, threaded and welded sleeves. ***Frank William Wood, Jr.*** *Product Engineering*, v. 30, no. 11, Mar. 16, 1959, p. 70-71.

7218 What's Coming in Welding. Here are the predictions of a dozen authorities. In evaluating their research and development efforts, they say that in five or ten years you'll be using some fantastic devices. *Steel*, v. 144, Mar. 30, 1959, p. 74-78.

7219 Tape Controlled Welding Is Paying Off at Convair. Missilemaker reports that the advantages include: short setup time, precision, and repeatability. Single unit handles two jobs automatically in turning out Terrier fins. *Steel*, v. 144, Mar. 30, 1959, p. 80.

7220* Fabricating Stainless Steel. III. Joining. Joining stainless steel requires special techniques in order to preserve the properties that dictated its selection as a construction material. The author relates joining methods to each class of alloy. ***Richard E. Paret.*** *Tool Engineer*, v. 42, no. 3, Mar. 1959, p. 119-124.

7221 Gas-Pressure Bonding of Flat-Plate Fuel Assemblies. Subscale flat-plate fuel subassemblies measuring up to 2 by 2 by 20 in., incorporating 16 Zircaloy-2-clad uranium-zirconium fuel plates and 15 coolant channels, were successfully fabricated by the gas-pressure-bonding process. Autoclave design, specimen-container configuration, and the design and preparation of specimen components were among the problems studied. ***Stan J. Paprocki, Edwin S. Hodge, Charles B. Boyer, and Ralph W. Getz.*** *U. S. Atomic Energy Commission, BMI*-1312, Jan. 20, 1959, 47 pp. (UF767 U3b Contin.)

7222 Welding of Type 347 Stainless Steel. High temperature tests were conducted on the following four compositions. Composition A - 19/9 Cb (7% ferrite present standard); Composition C - 19/13 Cb (0.12% carbon fully austenitic); Composition H - 19/13 MnCb (5% manganese fully austenitic); Composition F - 19/10 ELC (4% ferrite Type 308 ELC). ***V. N. Krivobok.*** *U. S. Atomic Energy Commission, TID*-7562, Jan. 1959, p. 1-13. (UF767 Un3ti Contin.)

7223 Welding of Stainless Steel Which Contains More Than One Per Cent Boron. ***Nicholas Balai.*** *U. S. Atomic Energy Commission, TID*-7562, Jan. 1959, p. 15-31. (UF767 Un3ti Contin.)

7224 Joining of Zircaloy to Austenitic Stainless Steel. Diffusion bonding in a vacuum furnace at 1000 to 1020 C gave good quality joints between Zircaloy-2 and 304 austenitic stainless steel which might be usable for joining some pressurized-water-reactor components. Joints brazed with pure Ag also had a moderately good tensile strength of about 35,000 to 40,000 psi but would not be usable for joints exposed to pressurized hot water corrosion. However, the joints brazed with pure Ag might find application for some reactor components now exposed to hot water. ***Kenneth H. Koopman.*** *U. S. Atomic Energy Commission, TID*-7562, Jan. 1959, p. 32-56. (UF767 Un3ti Contin.)

7225 Welding of Uranium. ***Robert A. Noland and C. C. Stone.*** *U. S. Atomic Energy Commission, TID*-7562, Jan. 1959, p. 57-76. (UF767 Un3ti Contin.)

7226 Welding Problems and Development Programs. ACF Industries. ACF Industries is a four-year program on welding of heavy heat treatable Al. They are concerned with thicknesses up to about six inches and are particularly concerned with improving mechanical properties through the use of new and

better filler alloys. ***Willis Groth.*** *U. S. Atomic Energy Commission, TID-7562,* Jan. 1959, p. 78-81. (UF767 Un3ti Contin.)

7227 Argonne National Laboratory. A greater portion of the welding development at Argonne has been associated with the design, development, and construction of cores for various types of reactors. ***Cecil Stone.*** *U. S. Atomic Energy Commission, TID-7562,* Jan. 1959, p. 82-98. (UF767 Un3ti Contin.)

7228 Battelle Memorial Institute. Discusses problems in making a small heat exchanger which consists only of a tantalum can with closely packed tantalum tubes in it. The major problem is the tube sheet joint which must be absolutely leak tight. ***David C. Martin.*** *U. S. Atomic Energy Commission, TID-7562,* Jan. 1959, p. 98-104. (UF767 Un3ti Contin.)

7229 Hanford Works (General Electric). There are three operating departments, supported by three service operations. Irradiation Processing Department is concerned primarily with those problems inherent to reactors; Chemical Processing Department with those which involve the treatment and recovery of fissionable materials; while Fuels Preparation Department is concerned with fabrication of fuel elements. *U. S. Atomic Energy Commission, TID-7562,* Jan. 1959, p. 104-111. (UF767 Un3ti Contin.)

7230 Oak Ridge National Laboratory. The Welding and Brazing Laboratory of the Metallurgy Division of Oak Ridge National Laboratory cooperates with the other laboratories of the Division in providing assistance and information to the various reactor projects and their related developmental programs. ***P. Patriarca.*** *U. S. Atomic Energy Commission, TID-7562,* Jan. 1959, p. 111-127. (UF767 Un3ti Contin.)

7231 Sandia Corporation Welding Techniques. Sandia is greatly concerned with specification and control of welding materials and processes so as to ensure maximum reliability. Also, as a development agency, Sandia is keenly interested in new welding techniques, in the welding of new materials, and in the capability of fabricating experimental models. ***C. F. Bild.*** *U. S. Atomic Energy Commission, TID-7562,* Jan. 1959, p. 129-135. (UF767 Un3ti Contin.)

7232 Welding of Inconel X. Inconel "X" fabrication in thicknesses other than sheet metal gages has shown a marked increase since it has been found that the alloy has outstanding properties in many nuclear power applications. ***K. M. Spicer.*** *U. S. Atomic Energy Commission, TID-7562,* Jan. 1959, p. 135-145. (UF767 Un3ti Contin.)

7233 Zirconium Welding. ***E. F. Cook.*** *U. S. Atomic Energy Commission, TID-7562,* Jan. 1959, p. 145-155. (UF767 Un3ti Contin.)

7234 Fabrication of Thin Wall Molybdenum Shapes by Welding. A detailed procedure for the fabrication of a thin walled tube is given. Sheet material 0.015 inches thick was used, and welding was done in air using the automatic inert-gas tungsten metal-arc process. The results indicate that thin molybdenum sheet material can be welded in air with the resulting joints exhibiting suffiicent ductility to permit fabrication and use when precautions are exercised in all phases of fabrication and assembly. ***W. F. Brown.*** *U. S. Atomic Energy Commission, TID-7562,* Jan. 1959, p. 155. (UF767 Un3ti Contin.)

7235 Practical Considerations in the Welding of Heavy Aluminum Plate. The most popular alloy for heavy aluminum fabrication continues to be alloy 6061, particularly for those instances where heat treatment can be accomplished after welding. There is some difference of opinion as to whether or not a satisfactory welding alloy has ever been developed for this material for use in heavy sections and the fact remains that base metal minimum tensile strength, yield strength, and ductility cannot be assured simultaneously. ***Willis Groth.*** *U. S. Atomic Energy Commission, TID-7562,* Jan. 1959, p. 173-180. (UF767 Un3ti Contin.)

7236 Welding Thin-Walled Uranium Cylinders. Several methods of fusion welding have been investigated at LASL. The inert gas, shielded arc method using a tungsten electrode and no filler metal proved to be the most satisfactory. ***E. L. Brundige, G. S. Hanks, and D. T. Doll.*** *U. S. Atomic Energy Commission, TID-7562,* Jan. 1959, p. 181-208. (UF767 Un3ti Contin.)

7237 Dynamic Properties of 6061-T6 Aluminum Weldments. ***D. W. Grobecker.*** *U. S. Atomic Energy Commission, TID-7562,* Jan. 1959, p. 209-225. (UF767 Un3ti Contin.)

7238 Inert Gases for Controlled Atmosphere Processes. Controlled atmosphere processes are used extensively for producing or fabricating metals such as titanium and zirconium. The four major impurities encountered in these operations are oxygen, nitrogen, hydrogen, and moisture. Estimates on the tolerable limits of these impurities have ranged from a low of about 10 parts per million for each specific impurity to a high of about 500 parts per million for their combined total. Lacking exact specifications, the general trend has been to provide atmospheres of the maximum purity obtainable. ***E. F. Gorman.*** *U. S. Atomic Energy Commission, TID-7562,* Jan. 1959, p. 226-253. (UF767 Un3ti Contin.)

7239* The Relining of Concrete Mixers by Hard Facing. The method used for the production of the welded lining involved the rotation of the drum of the mixer with the operator seated inside on a cradle suspended from a shaft passing through the drum. In this way the weld metal was deposited in the downhand position, the operator having a start/stop switch to control the rotation during the changing of electrodes. Circular beads were laid over the whole lining, a slight gap being left between each bead. ***J. W. Shedden.*** *Welder,* v. 27, no. 136, Oct.-Dec. 1958, p. 82-84.

7240* A Guide to Underwater Welding. In this article a brief appraisal has been made of the various conditions that must be considered, and guidance is given on how the welding should be carried out. ***Vincent R. Foster.*** *Welder,* v. 27, no. 136, Oct.-Dec. 1958, p. 88-92.

7241 Filler Metals for Joining. From the crude utensils and priceless jewelry of antiquity to the powerful autos and delicate electronic circuits of today, soft solders have experienced expanding use. The majority of all soft solders are tin-lead compositions which may be slightly modified with other metals. ***Orville T. Barnett.*** *Welding Engineer,* v. 44, Mar. 1959, p. 36-37.

7242 Submerged-Arc Welding Reclaims Blooming Mill Rolls. This welding procedure can be readily developed into a means of reclamation for prolonging the useful life of mill rolls and reducing the number of rolls ordinarily scrapped. With careful selection of welding wire for the final layer, maintenance and conditioning costs can be substantially reduced as well. ***J. J. Matusek.*** *Welding Engineer,* v. 44, Mar. 1959, p. 38-39.

7243 Welding Costs Are High—Here's Why. Welding costs can be cut by any designer or fabricator who tracks down and removes these six major causes of excessive welding costs: (1) overwelding; (2) use of fabricated components instead of structural shapes; (3) failure to use positioners; (4) correcting preventable distortion; (5) unwarranted postheat treatments; (6) lack of mechanized welding equipment. ***Bela Ronay.*** *Welding Engineer,* v. 44, Mar. 1959, p. 52 + 1 page.

7244 Electron Beam Welding—A New Development for Industry. Electron beam vacuum welding unit is capable of welding highly reactive materials with ease while reducing contamination and producing quality welds. ***W. I. Steinkamp and W. L. Wyman.*** *Welding Engineer,* v. 44, Apr. 1959, p. 38-40.

7245 Application Data on Kaiser's New Mig Techniques. Three new processes for MIG (metal inert-gas) introduced by Kaiser last year are given in detail. ***M. B. Kasen, George Allen, and F. R. Baysinger.*** *Welding Engineer,* v. 44, Apr. 1959, p. 44-47.

7246 Electro-Molding Replaces Forged Engine Components. Lighter, stronger, within closer dimensional limits than castings—that's the description used for locomotive engine components currently being welded at an Electro-Motive Div. plant of General Motors Corp. on Chicago's far south side. ***R. L. Peterson.*** *Welding Engineer,* v. 44, Apr. 1959, p. 52-54.

7247 Explosive Welding and Forming Open Another Door for Industry. Though still very much in an experimental stage at National Northern Corp.'s installations in West Hanover and Halifax, Mass., explosive welding is nevertheless a reality. ***Jack Fairlie.*** *Welding Engineer*, v. 44, Apr. 1959, p. 61 + 2 pages.

7248 Corrosion Tests on Metallized Coatings. In July 1950 the Committee on Metallizing of the American Welding Society prepared a test and evaluation program covering the corrosion protection of metallized Zn and Al coatings, applied to low-C steel. Results are now given. *Welding Journal*, v. 38, Mar. 1959, p. 215-221.

7249 Plastic Design in Welded Structures Promises New Economy and Safety. Plastic design departs drastically from the conventional elastic-design methods. Cases described in detail include the fixed beam uniformly loaded, continuous beams uniformly loaded, remarks on the tier-type of office building, and rigid frames of the type used for low factory buildings. ***Cyril D. Jensen.*** *Welding Journal*, v. 38, Mar. 1959, p. 222-231.

7250 Predicting Gap Change Reduces Trial Runs in Brazing Dissimilar Metal Joints. Gives calculations which will show whether the gap will expand or shrink and the approximate size of the change. From this information one can surmise whether the gap will be too large or too small to be brazed successfully and how much the alloy will be stressed if the gap tends to expand on cooling. ***D. C. Herrschaft.*** *Welding Journal*, v. 38, Mar. 1959, p. 232-235.

7251 Pressure Equipment for Low-Temperature Service. The use of ferrite materials must be a compromise between laboratory and theoretical knowledge of brittle fracture and the service record. ***C. R. Soderberg, Jr.*** *Welding Journal*, v. 38, Jan. 1959, p. 39s-44s.

7252 Welded Cantilever Wedge Beams. The objective of this investigation was the formulation of criteria predicting the load-carrying capacity of steel cantilever beams having tapered flanges and webs, called "wedge beams". The problem reduces essentially to the experimental determination of critical stresses at which such beams buckle elastically. ***W. J. Krefeld, D. J. Butler, and G. B. Anderson.*** *Welding Journal*, v. 38, Mar. 1959, p. 97s-112s.

7253 Effect of Zinc Coatings on Resistance Seam Welding of Sheet Steel. This report is the second of two pertaining to the effect of zinc coatings upon the variables encountered in the resistance seam welding of coated-steel sheets. ***C. W. Volek and M. L. Begeman.*** *Welding Journal*, v. 38, Mar. 1959, p. 113s-121s.

7254 High-Temperature Brazing Alloy-Base Metal Wetting Reactions. Reactions between five high-temperature base metals and six high-temperature brazing alloys have been determined in three different atmospheres at nominal and superheat brazing temperature levels. ***W. Feduska.*** *Welding Journal*, v. 38, Mar. 1959, p. 122s-131s.

7255 Aluminum Welding Using the Inert-Plus-Nitrogen-Gas Metal-Arc Process. Special gas-shielded metal-arc welding technique is developed to reduce the cost of aluminum welding and to make aluminum welding less dependent upon supply of inert gas. Typical applications include: (a) welding electrical bus bar, (b) welding aluminum alloy 3003 with 1100 alloy filler wire, and (c) welding aluminum alloy 6061 with 4043 alloy filler wire. ***George Allen.*** *Welding Journal*, v. 38, Mar. 1959, p. 132s-141s.

7256 Effects of Martensite, Bainite and Residual Stresses on Fatigue of Welds. Author relates the present knowledge of dislocation theory to some of the questions regarding weld fatigue. ***R. E. Keith.*** *Welding Journal*, v. 38, Mar. 1959, p. 142s-143s.

7257* Contribution to the Welding of Vacuum Vessels. The welding of vacuum-tight joints and special problems in welding "Kovar" alloy and less-heat-resisting materials. (*In Czech.*) Příspěvek ke svařování vakuových nádob. ***Albert Kloss.*** *Zváranie*, v. 7, no. 12, Dec. 1958, p. 356-362.

7258* Automatic Stud Welding Under Flux. (*In Czech.*) Automatické přivařování svorníků pod tavidlem. ***Miloš Záruba.*** *Zváranie*, v. 7, no. 12, Dec. 1958, p. 368-373.

See also: **6720** (brazed honeycomb sandwich panels); **6865** (welding of stainless steels); **6931** (nondestructive weld testing).

MISCELLANEOUS

7259* Joint Analysis of Experiments in Complete Randomised Blocks With Some Common Treatments. Intra-block analysis of a group of experiments where the treatments are not all the same, but one or more treatments are common to the whole set. ***Frederico Pimentel Gomes and Rubens Foot Guimaraes.*** *Biometrics*, v. 14, no. 4, Dec. 1958, p. 521-526.

7260* A Problem in the Combination of Accident Frequencies. Analysis of road accident frequencies before and after similar changes in road conditions are made at each of a number of sites. A method of estimating the average effect of the changes is proposed. ***J. C. Tanner.*** *Biometrika*, v. 45, pts. 3-4, Dec. 1958, p. 331-342.

7261 Controlled Cessation of Atomic Weapons Tests. The Russian viewpoint as expressed at the Third Pugwash Conference. Considers three feasible methods of detection. ***E. K. Fedorov.*** *Bulletin of the Atomic Scientists*, v. 15, no. 1, Jan. 1959, p. 8-11.

7262 U. S. Must Tap Oceans' Wealth. National Academy of Sciences says nation should step up its rate of deep-sea research. *Chemical and Engineering News*, v. 37, no. 9, Mar. 2, 1959, p. 62 + 1 page.

7263 Research Roles Reappraised. Management and research air views on what to expect of each other, find close agreement on basics. The company president should: define research policy clearly, keep his top research officer fully informed, avoid lumping research salaries under rules in effect elsewhere in the company. But management wants researchers to: return a profit in a reasonable time; acquaint themselves with over-all company problems; consider themselves part of the group, not people apart. *Chemical and Engineering News*, v. 37, no. 10, Mar. 9, 1959, p. 23-24.

7264* Explosion Protection in Industry. In former articles, details were given of techniques developed in Britain for the detection and suppression of explosions in industry. This article explains where and how these explosion protection techniques are applied and gives striking evidence of their effectiveness in a variety of industries. ***H. R. Maisey.*** *Chemical & Process Engineering*, v. 40, Mar. 1959, p. 83 + 2 pages.

7265 How Our Laws Protect Engineering Ideas. Problem—When you bid competitively to supply engineering services or equipment, can you prevent the purchaser from giving your ideas away to your competitor? Solution—Protection may come from a new trend in engineering ethics to forbid competitive bidding on engineering services. In the meantime, here's what our courts have said on this subject. ***Albert Woodruff Gray.*** *Chemical Engineering*, v. 66, Mar. 9, 1959, p. 158 + 2 pages.

7266* Inter-Communication Between Science and Social Studies. ***B. Monsaroff.*** *Chemistry in Canada*, v. 10, Oct. 1958, p. 42 + 1 page.

7267 Motivation—A Management "Must". Motivation will produce results if it is given the benefit of objective thought, good planning, determined application, and close observation. ***R. B. Hewes.*** *Coal Age*, v. 64, Jan. 1959, p. 90-93.

7268* Note on a Computation Method in the Theory of Games. Applies in connection with linear programming problems, or in the consideration of zero-sum two person games in normal form. ***Harold N. Shapiro.*** *Communications on Pure and Applied Mathematics*, v. 11, no. 4, Nov. 1958, p. 587-593.

7269* Opposition to New Ideas. Explains twelve common ways in which people express refusal to believe new concepts

or inventions. ***Neil Macdonald.*** *Computers and Automation*, v. 8, Feb. 1959, p. 20 + 3 pages.

7270 Deterioration of Wood by Marine Boring Organisms. Creosote prevents attack by the Teredine or shipworm type of marine borer and by two of the three species of *Limnoria* present in U. S. harbors but one species, *Limnoria tripunctata*, which thrives in warm waters, successfuly attacks creosoted wood. ***H. Hochman.*** *Corrosion*, v. 15, Jan. 1959, p. 61-64.

7271* Thinking and Discovery. Discusses the thinking that leads to scientific discoveries. ***Magnus Pyke.*** *Discovery*, v. 21, Feb. 1959, p. 74-76.

7272* Using Fourier Analysis in Designing Whole Systems, Subsystems, and Electrical and Mechanical Devices. A basic approach to the applications of Fourier analysis is given. ***Ira Ritow.*** *Electrical Manufacturing*, v. 63, Feb. 1959, p. 87-102.

7273* Doppler and the Doppler Effect. The Doppler effect is today applied in themes ranging from aerial navigation to the expanding universe. This article describes the origin of the principle, which was first put forward with astronomical application in view, its history and present employment. ***E. N. da C. Andrade.*** *Endeavour*, v. 18, no. 69, Jan. 1959, p. 14-19.

7274 Airborne Direction Finding—The Theory of Navigation Errors. A probabilistic solution to the ground-based direction-finding problem has been worked out by Stansfield. Stansfield's solution is here extended to include the case of airborne direction finding, which introduces uncertainties in the locations of the direction-finding stations. ***Clinton J. Ancker, Jr.*** *IRE Transactions on Aeronautical and Navigational Electronics*, v. ANE-5, no. 4, Dec. 1958, p. 199-210. (TK1 In6.6a Vis.)

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7291* Secondary Obstructions for Fibre Spaces. The aim of this note is to set up machinery for the computation of the second obstruction cohomology class to the extension of a cross-section of a fibre space. $F \longrightarrow iE \longrightarrow pB$, with base B a simply connected C-W complex, and connected fiber F, total space E, projection map p and inclusion i. This research was supported in part by OOR, U. S. Army. ***Robert Hermann.*** *American Mathematical Society, Bulletin*, v. 65, no. 1, Jan. 1959, p. 5-8.

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7293* The Conjugate Fourier-Stieltjes Integral in the Plane. This research was supported by the United States Air Force through the Air Force Office of Scientific Research of the Air Research and Development Command. ***Victor L. Shapiro.*** *American Mathematical Society, Bulletin*, v. 65, no. 1, Jan. 1959, p. 12-15.

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7296* Finite Markov Chains and Their Applications. Recent applications of mathematics to the behavioral and biological sciences have emphasized the importance of Markov chains as a stochastic model. Because of this interest, it seemed important to develop a unified treatment of the descriptive quantities of a Markov chain. ***J. Laurie Snell.*** *American Mathematical Monthly*, v. 66, no. 2, Feb. 1959, p. 99-104.

7297* Trigonometric Sums in Elementary Number Theory. ***Eckford Cohen.*** *American Mathematical Monthly*, v. 66, no. 2, Feb. 1959, p. 105-117.

7298* An Elementary Treatment of the Imbedding of a Graph in a Surface. The object of this paper is to give a simple proof of the following theorem of König: Any connected graph may be imbedded in an orientable surface so as to form the vertices and edges of a map. ***J. H. Lindsay, Jr.*** *American Mathematical Monthly*, v. 66, no. 2, Feb. 1959, p. 117-118.

7299* Philosophical Embarrassments of Psychology. Modern psychological research and modern logical and methodological analysis may have much to offer to each other. A more liberal view of the nature of scientific theory may help psychologists more adequately and clearly to assign to psycholoy its proper place in the uniting sciences and to remove many of the philosophical embarrassments that have stood in the way of scientific progress. ***Herbert Feigl.*** *American Psychologist*, v. 14, Mar. 1959, p. 115-128.

7300* An Opinion on the Construction of Behavior Theory. The author's suggestions are based on the conviction that theory can and must assume as integral a position in the behavioral sciences as it has in physics. To fulfill this position it must be capable of extending ideas and perspectives beyond the limits of existing experimental data and verbally mediated intuition. ***Thornton B. Roby.*** *American Psychologist*, v. 14, Mar. 1959, p. 129-134.

7301* The Psychology of the Recession. ***George Katona.*** *American Psychologist*, v. 14, Mar. 1959, p. 135-143.

7302* Human Quality Control in Naval Air Training. Present findings indicate that minimum standards already installed and under investigation should reduce the number of unsatisfactory men reaching the fleet by about 50%. ***James R. Berkshire.*** *American Psychologist*, v. 14, Mar. 1959, p. 153-155.

7303* Education and Science. What we need is not so much a universal genius as a broad base of mutual understanding between all physical scientists and all social scientists. ***Guy Suits.*** *American Scientist*, v. 47, no. 1, Mar. 1959, p. 60-67.

7304* The Theory of Matrix Polynomials and Its Application to the Mechanics of Isotropic Continua. In this paper it is shown that a symmetric isotropic matrix polynomial in any number of symmetric 3 x 3 matrices can be expressed as a symmetric isotropic matrix polynomial, in which each of the matrix products is formed from at most, six matrices, and has one of a certain number of forms which are explicitly given. The significance of these results in the mechanics of isotropic continua is indicated. ***A. J. M. Spencer and R. S. Rivlin.*** *Archive for Rational Mechanics and Analysis*, v. 2, no. 4, Jan. 19, 1959, p. 309-336.

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7309* The Conservation of Engineering Talent. It is the responsibility of management to evaluate its policies so that an engineer's best rewards will, in the long run, come from an honest use of his best abilities. However, only by equalization of compensation will engineers be willing to correctly and objectively evaluate themselves in pursuing their professional careers. ***H. A. Finke.*** *Microwave Journal*, v. 2, Feb. 1959, p. 4-5.

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7321* What Management Expects of Research and Members of Its Research Staff. Quality is a better criterion of research effort than quantity of research, number of scientific personnel, or size or appearance of a laboratory. On the part of the industrial research department, management must expect a raise of the earning power of the company. The predominant effort must be in applied research. ***A. B. Layton.*** *Paper Trade Journal*, v. 143, Mar. 9, 1959, p. 57-60.

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